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Rotors and Turbines

WE must hope that we shall not be arraigned on charges of smugness, complacency or un-American activities if we observe that New World orders for British turbine airliners are now accepted on both sides of the Atlantic as a matter of hard business. Cool millions are being staked on the Viscount, Vanguard, Comet and Britannia by some of the world's biggest and shrewdest operators. But whereas even years ago the student of form might reasonably have forecast these fixed-wing successes, he could hardly have tipped our helicopters as equally good bets, for the late 1950s, on the Americans' home ground.

As we have implied, the fixed-wing operators in the States are not in business for the benefit of their health (their record of ulcers is known to be an impressive one); still less are the rotary-wing pioneers sticking their necks out—as they indeed are—just to inhale the air above the great cities. They are in a tough game, and they have an especially tough problem at this stage in finding the right equipment for their needs. Hear a chief among them, Mr. Robert L. Cummings, Jr., president of New York Airways, whose activities we describe, first-hand, in this issue:

"Just as Capital went abroad to buy the Viscount," says Mr. Cummings, "present indications are that we may well be doing similarly in order to find appropriate equipment to render the best possible service to the public." The Fairey Rotodyne, in Mr. Cummings' opinion, gives very real promise of being able to perform the required operations, though he explained to a *Flight* representative a few days ago that the time for this "big ship" is "not necessarily yet," and that the market for it is "in the longer hauls." What would really make him happy at this time would be a 20/25-seater; and in declaring that "Bristol seem to shape up nearest to our plans" he has in mind a developed version of the Bristol Type 192 (pages 69-71) with Napier Gazelle gas turbines.

Made for Each Other

The bright promise of the coming generations of transport helicopter, so dear to Mr. Cummings' heart and so necessary to his airline's economy, must, of course, be largely attributed to the light weight and abundant output of their powerplants. It is the brilliant performance of these units—principally the Gazelle and Eland—that will bring reality to Britain's rising hopes in the world helicopter market.

We are not suggesting by this that the labours of Mr. Penn and his Napier colleagues will allow the airframe designers to take time off, for the most prodigious engine can never transform a bad, or even mediocre, helicopter into a world-beater. The rotary-wing aircraft, especially the medium and large passenger and freight carrier, has reached a critical phase of its development, and the airframe designers must tax their ingenuity to the limit if they are to match the qualities of the new turbines with their structures and aerodynamics. Soon the fixed-wing, short-take-off-and-landing aircraft—the "STOL"—will be making its own strong challenge, and only bold, deft engineering will enable rotary wings to survive the fate of the windmill. That British designers are alert to this is, happily, apparent. An unsolicited testimonial to the promise of the Rotodyne and Bristol 192 has been given by Mr. Cummings; it remains to add that work is well ahead on the twin-Eland Westland Westminster, which may ultimately prove a potent rival of the similarly powered Rotodyne, and that design thinking at Bristol is represented by the 160 m.p.h. twin-Gazelle Type 194 (page 69).

Should it be argued that the future of transport helicopters will not be solely dependent on airframe and powerplant performance, and that the problem of navigation, for example, is as pressing as any other, then we would hasten to agree —and to remark that a strongly fancied item of equipment among American helicopter operators, military as well as civil, is the Decca Navigator, made at New Malden, in the county of Surrey, England.

FROM ALL QUARTERS

The R.Aux.A.F. and R.N.V.R.

AS we go to press, reports of the disbandment of the entire R.Aux.A.F. (except for a small number of the Fighter Control Units) and of the entire R.N.V.R. Air Branch have reached the status of semi-official announcements. Any confirmation from the Minister of Defence or the Secretary of State for Air has, however, been delayed by last week's changes in the Government.

It appears certain that a definite and planned move towards immediate disbandment of some thirty R.Aux.A.F. and R.N.V.R. flying squadrons, not to mention numerous ground units, has now been made, and concerted resistance to such a move has already begun to manifest itself in the daily Press. Whatever the pros and cons of the situation the Auxiliaries themselves are not likely to go into liquidation without a stiff struggle; and they will point out that disbandment would not effect a great financial saving, while the loss of a score of day fighter squadrons would be a real blow to Britain's air defence.

1957 Air-Racing Plans

TWO race meetings are being planned for this year by the Royal Aero Club, the first at Yeadon on June 10 and the second at Coventry on July 13. The races will generally follow last year's pattern, except that there will be three classes instead of four, and the King's Cup Race will take a different form (a triangular 112-mile circuit covering Coventry, Northampton and Peterborough).

A new aerobatic competition, in addition to the Lockheed International contest, is also on the 1957 programme. It has been designated the Royal Aero Club Aerobatic Competition, is limited to British entries, and is sponsored by Automotive Products, Ltd. This new contest will take place at the Yeadon meeting, and the Lockheed competition at Coventry.

As already announced, the International Air Rally originally planned for May 18-20 has been postponed until 1958.

British Medium Jets?

REFERENCE was made in a B.B.C. news bulletin last week to new medium jet airliner projects which, the B.B.C. air correspondent stated, were in course of being designed by Vickers-Armstrongs and Bristol. The name of B.E.A. was linked to these projects and it was stated that the Bristol design had engines grouped as a tail cluster, and that those of the Vickers design were slung in pods beneath the wings. While Bristol, Vickers and also de Havilland are known to have been examining the possibilities of the medium jet, for obvious reasons none of these firms yet wishes to make official reference to its studies.

Lord Hives Retires

LAST Friday, January 11, Lord Hives, C.H., M.B.E., retired from the position of executive chairman of Rolls-Royce, Ltd., after having served the company continuously for 48 years. To mark the occasion a dinner was held in the Rolls-Royce welfare hall in Derby, attended by over 270 of Lord Hives' old associates from all levels of the organization.

Lord Kindersley, the new chairman, presided. Tributes to "HS"—to be reported in these columns next week—were paid by Mr. J. D. Pearson, the new chief executive and deputy chairman; Mr. W. A. Robotham, managing director, oil-engine division; Dr. F. Llewellyn Smith, managing director, car division; Mr. C. P. Jones, general works manager; and Mr. Alf Brown, the works convener. Tribute was paid to Lady Hives by the company financial director, Mr. W. T. Gill.

Crusaders Delivered

ON December 28 the first F8U-1 Crusader supersonic, carrier-based fighters for squadron service were delivered to the Naval Air Test Center from the Chance Vought plant in Dallas, Texas. The delivery was made 21 months from the first flight of the first prototype and 26 months from the original mock-up. Crusaders have been in production since September 1955 and large numbers have been scheduled for the fleet indoctrination programme which is now in full swing.

New Lansen Variant

A PHOTOGRAPH opposite depicts the first of a large batch of more powerful Lansen two-seat machines which have been developed for the Royal Swedish Air Force by the Saab Aircraft Company of Linköping. It differs from its predecessors (which are now in widespread squadron service) chiefly in having an advanced version of the Rolls-Royce Avon, fitted with a new afterburner which gives extremely high thrust for the night-fighter rôle; earlier Lansens were low-level attack aircraft.

Development of the new fighter, which is designated Saab J 32B, has been undertaken during the past two or three years by Saab, the Swedish Air Board and Svenska Flygmotor, A.B. (who manufacture the engine under licence). Less obvious improvements are what are described as "a new navigation and fire-control equipment" and "a new and powerful armament," both of which have been developed especially for night and all-weather combat.

Blown-Flap N.113 on the Deck

A SUCCESSFUL series of deck landings and catapult launches, using the "blown" flaps which will be a feature of the production-type Supermarine N.113, has been completed by a prototype of this naval fighter/bomber. Vickers-Armstrongs (Aircraft), Ltd., announce that the new flap system has much improved the N.113's handling characteristics and has achieved an appreciable reduction in the approach and catapult-launching speeds. The deck trials, which followed ground catapulting trials and ADDLS (dummy deck landings), were conducted between January 4 and 8 off the south coast of England. The pilots were "Mike" Lithgow, the contractors' deputy chief test pilot, Cdr. P. C. Chilton, R.N., and Lt-Cdr. J. D. Whitehead, R.N. A makers' announcement states that the flap-blowing system is operated by high-pressure air, fed from each [Rolls-Royce Avon] compressor to the top surface of the flaps through a spanwise slot along the rear of the wing in the flap shroud. The effect of this high-velocity air is to delay the onset of turbulence and consequent loss of lift in the airstream over the wing at high angles of attack and at low speeds. "Blow" is obtained automatically when the flaps reach 10 deg, or it can be manually selected.

***FOR THE SEA BATTLE:** The four-engined landplane on tow is the first Canadair CL-28, a maritime-reconnaissance development of the Bristol Britannia. Its "roll-out" has already been reported in our columns. In position for catapult launching is the Supermarine N.113 carrier-borne fighter/bomber, subject of a news item on this page.*

FOR THE LAND BATTLE: The Auster A.O.P.9 above is one of two for the South African Air Force. Differences from R.A.F. standard are the "Springbok" markings, the fitting of sunblinds and provision for an F.24 camera. On the right is a new, and attractive, view of the Fiat G.91 light ground-support fighter (Bristol Orpheus turbojet).

Recognition Par Excellence

A TEAM from the Royal Netherlands Air Force Aircraft Recognition School at Breda is participating for the fifth successive year in the tenth All-England Aircraft Recognition Competition, which is being held at the Royal Institution, London, tomorrow, January 19.

Fifty-six teams of three members each, are taking part in the competition, which is organized by the Aircraft Recognition Society. The Air Training Corps (which is entering 28 teams) and Service representatives compete for special trophies, but all competitors are eligible for the highest award, the Silver Hurricane, which has been held for several years by the Royal Observer Corps.

Mr. Peter Twiss is to attend the competition as independent umpire and Mr. Peter Masefield, president of the Society, will present the trophies.

Analogue Computors in Helicopter Design

THE application of electronic analogue computor techniques to the study of helicopter design problems provided the subject for discussion at the January meeting of the Helicopter Association, which took place last week. The lecturer was Mr. B. H. Venning, B.Sc., of the electronics department, Southampton University.

After giving background information on the origins and general characteristics of analogue computors, Mr. Venning went on to outline recent work by his department in the construction of a computor designed specifically to solve equations arising from analysis of the ground-resonance problem in single-rotor helicopters. A research grant had been made by the Ministry of Supply for the purpose and there had been close collaboration with a number of helicopter constructors in the industry.

The analogue computor constructed by the University was capable of dealing with four linear second-order differential equations and the speed at which solutions could be obtained made it possible to prepare design curves for a wide variation of damping and stiffness in the undercarriage and blades. These curves gave an indication of the unstable ranges and from them it was possible to determine the degree of damping necessary to remove the instability.

The work was still in progress and a number of refinements had been planned for the future. One of these was to enable the computor to deal with various non-linear parameters, such as changes in stiffness when a shock-absorber became compressed, and for simulating damping forces other than those due to viscous damping. Use of the new computor techniques would make it possible to allow for effects such as these which occurred in practice but which could not easily be incorporated in straightforward mathematical analysis.

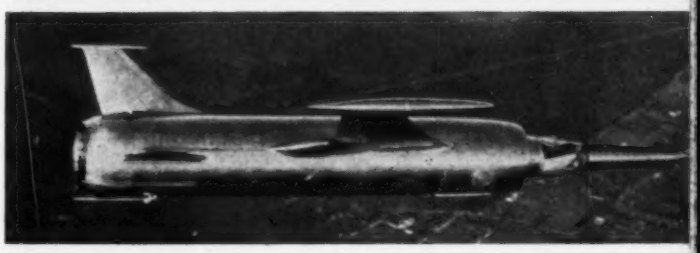
R.Ae.C. Appointments

THE Royal Aero Club announces that W/C. H. G. L. Allsop has been appointed house secretary as from January 1, 1957. It is also stated that G/C. J. F. H. du Boulay, C.B.E., D.F.C., is shortly leaving the service of the Club in order to take up a commercial appointment.

Constitution of two R.Ae.C. committees for 1957 is as follows:

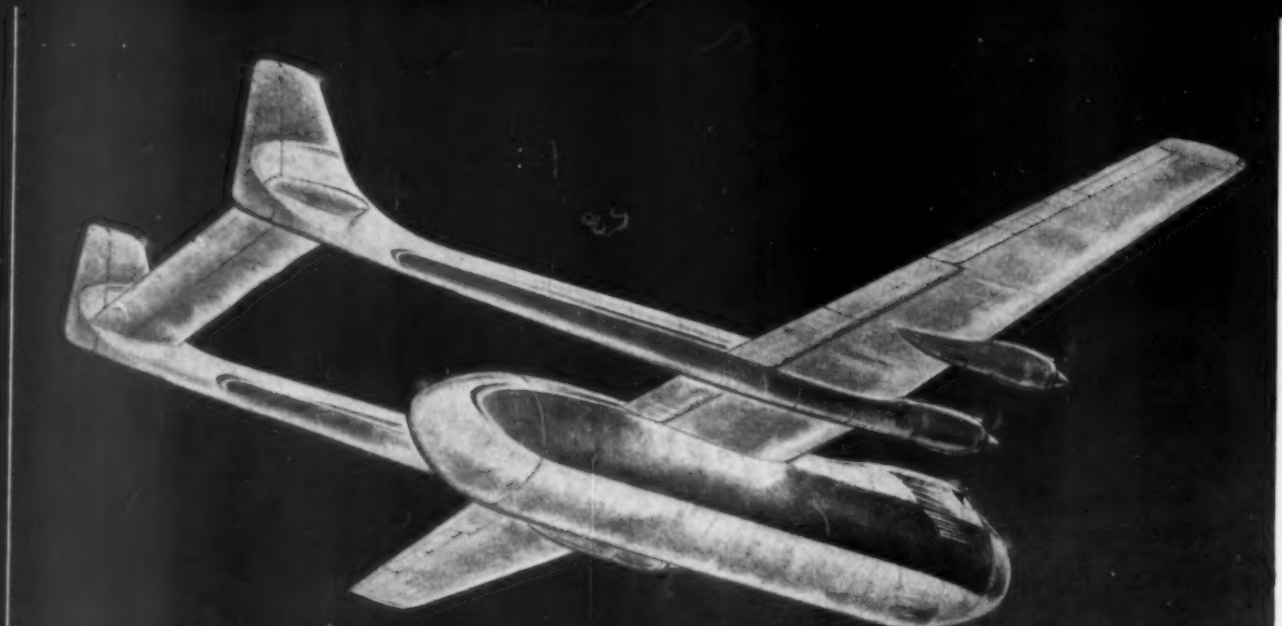
House Committee.—L. R. E. Castlemaine; Maj. A. J. Michell-Clarke; J. G. Crammond; E. J. Earnshaw; G. B. Fellows; S/L. W. A. R. Harris; S/L. C. K. Turner-Hughes; R. G. Kent; E. H. W. Lucas; G/C. C. S. Morice; Capt. J. G. Renton; Maj. J. Stewart; L. Swan; J. C. C. Taylor; Capt. R. H. Walmsley; G. H. Wilkinson.

Aviation Committee.—Air Chief Marshal J. N. Boothman; B. F. Collins; H. Best-Devereux; J. J. Dykes; Lt-Col. C. F. H. Gough; R. E. Hardingham; S. Scott-Hall; F. N. Hillier; W. I. Scott-Hill; A. F. Houlberg; V. A. M. Hunt; N. Jones; H. B. Lindsay; Maj. R. H. Mayo; G/C. E. L. Mole; Maj. H. A. Petre; B. J. Snook; J. N. Somers; Whitney W. Straight; J. C. C. Taylor; P. A. Wills; F. Woodhead.



THRUST BOOSTING: Centre, above, the J 32B all-weather fighter development of the Saab A 32A Lansen attack aircraft has a later series of Rolls-Royce Avon with enlarged afterburner, as noted in a news item opposite. Below it is the Leduc 022, France's supersonic ramjet-development aircraft. The 6,600 lb thrust of an Atar turbojet will be supplemented at full speed by 132,000 lb ramjet thrust.

WASH AND BRUSH UP in the Boeing Airplane Company's flight-test centre at Seattle before another day's work. In the foreground is the 707 prototype; next are the first two KC-135 military tankers; and last a B-52 bomber. The 707 now has 650 flight hours behind it, and its nose bears the insignia of eleven airlines which have already ordered production versions to a total of 132 aircraft.



FREIGHTLINER

First Details of Armstrong Whitworth's New Transport

FOR several years it has been evident that no existing or projected aeroplane could fairly claim to be as versatile a medium-range, multi-purpose transport as current design techniques permit. There are, it is true, several efficient passenger or freight machines, but none combine the attributes of the fully proven turboprop with a capacious and completely versatile fuselage while, at the same time, offering characteristics suited to world-wide civil or military operation.

Under the general direction of Sir Arnold Hall, technical director of the Hawker Siddeley Group, Armstrong Whitworth Aircraft, Ltd., of Baginton, Coventry (chief designer, E. D. "Dixie" Keen), have conducted an exhaustive market survey into the optimum characteristics and sales-prospects of such a machine. For over a year Armstrong Whitworth have been engaged in project design-work on the type of aeroplane which has now emerged in final form as the A.W.650 Freightliner. We are now able to publish a preliminary specification of the A.W.650, together with a three-view drawing.

Throughout the design there is evidence of the attention which has been paid to meet the conflicting requirements of versatility, performance, reliability, economy, ease of maintenance and, in fact, all the manifold factors which can increase its appeal to the widest possible market. Altogether the project is of unusual interest in that it represents the tackling, by our largest aircraft-manufacturing group, of a wholly new species of problem. There is every reason to believe that the programme will prove to be a text-book example of how things should be done.

As described below, there will be more than one standard version, although it is intended that all variants will be powered by Rolls-Royce turboprop engines. What will probably be the most numerous version is that illustrated here, in which four Dart 525-series engines (RDa.7/2 rating) are matched with a pressurized fuselage with a section similar to a scaled-up Ambassador. Alternatives are an unpressurized hull of exceptional width, capable of taking vehicles side-by-side; a choice in fuselage length, to meet variable payload/range requirements; and a later aeroplane powered by two Tynes, offered with the same alternative body forms.

It is clear, therefore, that a major key to the versatility of the A.W.650 lies in its hull configuration. The drawings depict the basic version, suitable for passengers or freight; the "long" fuselage is shown, the shorter alternative having a capacity of about 3,000 cu ft. A unique feature is the provision of one-piece full-width doors at both ends, giving unrestricted access to the 10ft-wide interior; inbuilt ramps can be provided if necessary. When loaded, the level floor is at typical truck height and it is provided with freight lashing points and fixtures for seating at various pitches. Vertical clearance under the wing spars is nowhere less than 7ft and the interior is completely unobstructed.

Great care has been taken to achieve an optimum fuselage volume and cross-section. Carriage of freight is facilitated by the extreme ease of loading and unloading, which should not only accelerate operations and increase utilization but should also effect a significant reduction in overall ton-mile costs. Where passengers must also be carried they can enter through a separate door, with inbuilt steps, at the rear on the port side. In all-passenger service the A.W.650 can be equipped with triple seats on either side of a central aisle, seating 71 at 38in pitch or 82 at 32in pitch, in both cases with ample toilet and galley facilities.

In a military role—in which case the aircraft bears the designation A.W.660—it will be possible to carry a wide range of stores and vehicles, and to air-drop these through the rear doorway (the rear door being of entirely different form from that illustrated, with provision for opening and closing in flight—when the interior is not pressurized). In a trooping or paratroop conversion it will be usual to seat fully equipped soldiers transversely, five-abreast.

As a specialized car ferry—already an important and expanding market—the A.W.650 can be provided with an *ad hoc* unpressurized fuselage of dimensions ideally suited to such work. It will have a floor-level width of no less than 174in (14ft 6in), and will accept vehicles—up to the size of a large car—stowed side-by-side. On short and medium stages it will be possible to carry six cars and 30 passengers, the basic machine being otherwise identical with the standard A.W.650.

It should, perhaps, be emphasized that Armstrong Whitworth are not envisaging a quickly demountable fuselage—after the manner of the Fairchild XC-120 "Pack-Plane"—which can be loaded in advance and attached to the aircraft before flight. Each Freightliner will be built as a finished aeroplane, and any change to a different body-form could only be done as a major job by the manufacturer. One of the chief reasons for this is that, although the flight deck and hold are built up with frames of different radii, the entire interior is pressurized as a single pressure-hull.

In any of its configurations the new transport promises to offer the ultimate in operational flexibility. Although the maximum short-range payload is no less than 28,000 lb the economic value of the machine will not be dependent on the maximum load carried. The extreme ease of loading should permit utilization to be very high, particularly when taken in conjunction with the proven reliability of the powerplants and the heavy accentuation of the need for simplicity and sheer good engineering. Another factor, which certain operators—particularly those with high seasonal traffic variation—will welcome, is that it will be relatively simple to switch from passenger to freight operation, or to handle both classes of traffic at once.

Initially the major design effort is being concentrated upon the A.W.650, with four Darts. Selection of this engine is a "natural," and it is rare indeed for a manufacturer to be able to plan an entirely new and competitive machine upon such well-tried transport powerplants. Each is installed in a conventional bulged Viscount-like cowling, with jet exhaust below (outers) or at the side. In this type of aeroplane jet thrust is of secondary importance and the propeller horse-power is all-important. The propellers will, in fact, be Rotol units, with a diameter of 11ft 6in —appreciably larger than those of the Viscount, but similar to those specified for later (RDa.7) Friendships. Fuel will be carried in bag-type tanks between the wing spars, the capacity normally amounting to 3,300 Imp. gal.

At a somewhat later date it is probable that certain operators will be attracted by the possibility of fitting two Tynes. At present the engine-out certification requirements for such an aeroplane would, in adverse circumstances, limit the payload. Nevertheless the Tyne's greater efficiency and lower installed drag and weight are likely to have great appeal, particularly when the engine becomes available in later versions delivering appreciably more than 5,000 s.h.p. At present the twin-Tyne study has the type number A.W.651.

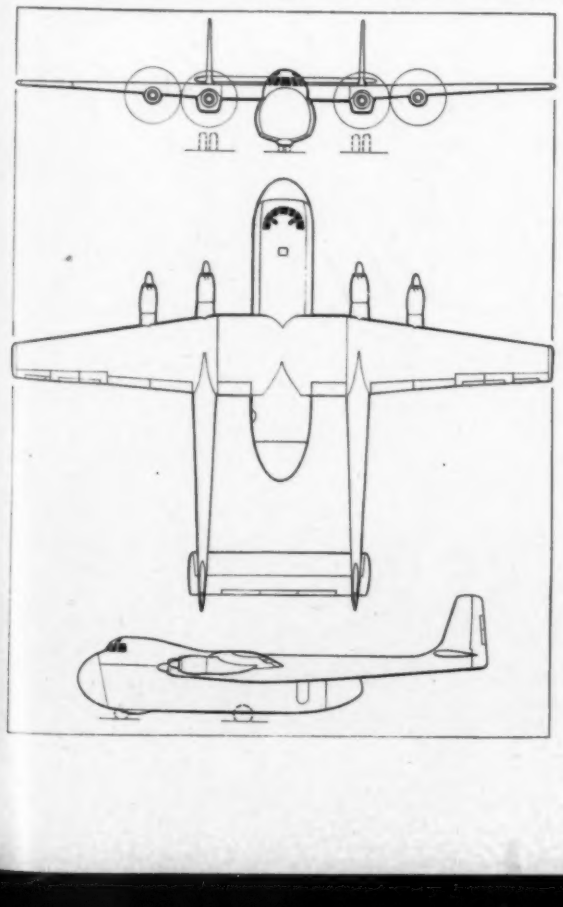
Clean-limbed is a good adjective to apply to the airframe. Great attention is being paid to achieving a long safe life, appreciably greater than the probable life-span of the aircraft. Virtually the whole structure is conventionally built from light alloy.

In order to accelerate development, and draw directly upon existing fatigue experience, it has been found possible to make the wing similar in several respects to that of an Avro design with a long background of operational use. It is a two-spar structure with a high aspect ratio and very efficient weight-lifting qualities, which have been improved by fitting entirely new double-slotted flaps, with hydraulic operation. All flying controls are conventional manual systems, with spring tabs and tension-compensated cables. The elevators are horn-balanced.

Both main undercarriage units and the nose gear employ twin wheels, with moderate-pressure tyres. The main units are of wide track and have differentially actuated hydraulic brakes with an anti-skid control. All units retract rearwards hydraulically, and the nose gear, which is steerable, folds into an unpressurized underfloor box standing proud of the underside of the hull.

The flight deck is entirely above the usable fuselage volume, and studies have shown that the pilot view will be exceptional. Provision is made for an operating crew of two or three, with plenty of room for supernumeraries. Like the rest of the fuselage, the crew space is pressurized to a maximum dP of 5.5 lb/sq in by blowers driven from three of the main engines; a cold-air unit and heater are also specified. De-icing of the wing is effected by hot air, drawn from powerplant heat exchangers. Emergency power services are pneumatic. As far as is practicable, Armstrong Whitworth will increase "systems" safety and utility by employing only well-proven components.

This three-view general-arrangement drawing depicts the standard A.W.650 with four RDa.7/2s and a full-length fuselage, corresponding with the tabulated data. Fuselage window-positions are not shown.



ARMSTRONG WHITWORTH A.W.650

Provisional data with four Rolls-Royce Dart RDa.7/2 each rated at 2,100 maximum e.s.h.p.

Basic Dimensions: Span, 115ft; length, 86ft 9in; height, 27ft; gross wing area, 1,419 sq ft; aspect ratio, 9.32.

Dimensions of Hold: gross volume available for freight, 3,680 cu ft; floor area, 426 sq ft; overall length, 47ft; width at floor level, 10ft; maximum width, 11ft 8in (140in); maximum height, 8ft 9in (105in); minimum height, 6ft 8in (80in); floor height above ground, aircraft loaded, 4ft; minimum dimensions of forward door, 8ft 4in wide by 6ft 8in high; minimum dimensions of rear door, 8ft 8in wide by 6ft 8in high (both doors pressurized in flight).

Weights and Performance: maximum weight, 76,000 lb as basis for initial C. of A. application, with early development to at least 82,000 lb; payload (with normal cruise in still air in standard atmosphere with reserves for 230 statute miles plus 45-min stand-off), 28,000 lb up to 500 st.m., 26,500 lb at 1,000 st.m., 22,000 lb at 1,500 st.m. and 17,500 lb at 2,000 st.m. (fuselage cross-section chosen to provide maximum usability for economic operation on stages up to 2,300 st.m. with reserves); mean t.a.s. at cruising power at 25,000ft, 296 m.p.h.; standard-atmosphere take-off balanced field length, 3,500ft at 76,000 lb rising to 4,200ft at 82,000 lb.

To sum up, then: Armstrong Whitworth are to offer a machine exceptionally well suited to civil freighting, passenger "coach" transport and various military rôles. According to operator preference (route structure, mean payload density and other factors) fuselage length can be varied; thus, for certain operations, a cheaper and lighter machine can be evolved by eliminating a number of 20in frames. A special wide hull will be available for car-ferrying. There will also be a choice of powerplant.

Design of the basic A.W.650, as depicted here, is proceeding on schedule. The first machine will be built at Baginton in production jigs and is scheduled to fly before the end of 1958. Armstrong Whitworth have an outstanding record of military production, both as regards quality, quantity and low cost.

As a company venture, production of ten A.W.650s is already being planned. All ten will be equipped—the majority as freighters—for exhaustive trials and for full A.R.B. and C.A.A. certification up to intercontinental maximum conditions. Tropical trials will be conducted at a later stage in development. Armstrong Whitworth are not yet prepared to quote a price but there is every reason for believing that, like the aeroplane itself, it will be extremely competitive.

HONOURED BY THE I.A.S.

AT the Institute of the Aeronautical Sciences "Honors Night Dinner," to be held in New York on January 28 as part of the four-day I.A.S. 25th annual meeting (which continues until the 31st), A. Cdre. F. R. Banks and Mr. H. F. Guggenheim are to be formally announced as recipients of Honorary Fellowships, the highest honour the I.A.S. can bestow.

A. Cdre. F. R. Banks, C.B.E., O.B.E., F.R.Ae.S., M.I.Mech.E., F.Inst.Pet., director with engineering duties at the Bristol Aeroplane Co., Ltd., since October 1954, is also a director of Bristol Aircraft, Bristol Aero Engines, Bristol Aeroplane Co. of Canada, and Rotol. From 1952-3 he was Principal Director of Engine Research and Development at the M.o.S., "on loan" from the Associated Ethyl Co., Ltd., whom he rejoined in 1953 before going to Bristol. Lately, unhappily, he has been seriously ill and it is improbable that he will attend the Washington meeting.

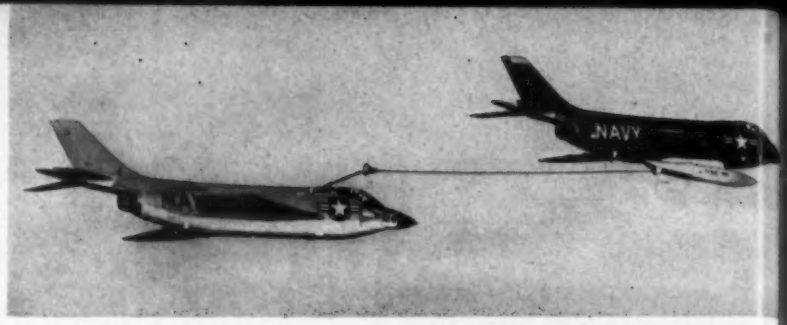
The other recipient of an Honorary Fellowship, Mr. H. F. Guggenheim, is senior partner in the mining and metallurgical firm of Guggenheim Bros.

Two of the three non-Americans elected to I.A.S. Fellowships for 1956 are British. They are Professor A. R. Collar, M.A., D.Sc., F.R.Ae.S., A.F.I.A.S. (who has held the Sir George White Chair of Aeronautical Engineering at the University of Bristol since 1946 and from 1941-45 was senior research scientist in the structural and mechanical engineering department of the R.A.E., Farnborough) and Mr. Stewart Scott-Hall, C.B., M.Sc., F.C.G.I., D.I.C., F.R.Ae.S., A.F.I.A.S., Scientific Adviser to the Air Ministry. Before joining the Air Ministry last October, Mr. Scott-Hall was for three years head of the Ministry of Supply Staff at the British Joint Services Mission in Washington. Prior to that, he was Director-General (Air) at the M.o.S.

For the I.A.S. meeting itself an extremely comprehensive programme of lectures has been arranged—in the words of an official handout, there are "94 papers slated for airing." Among them are:—

Effects of Compressibility on Air Flow at Very Low Reynolds Numbers (Prof. Sir G. I. Taylor, Trinity College, Cambridge); *The Jet-augmented Flap* (J. G. Lowry, J. M. Riebe and J. P. Campbell of the N.A.C.A. Langley Aeronautical Laboratory); *Inviscid Flow Field about Blunt Bodies at Hypersonic Speeds* (S. H. Maslen and W. E. Moeckel, N.A.C.A. Lewis Flight Propulsion Lab.); and *Evaluation of VTOL Systems Suitable for Transport Aircraft* (W. Z. Stepniewski and J. Mallen, Vertol Aircraft Corporation).

HERE AND THERE



TRIAL BY DEMONS: A flight-refuelling trial, using McDonnell Demons, as described in a paragraph on this page. It appears that the probe of the receiver aircraft is intended to retract into a horizontal fairing.

Royal Visit

THE Queen and the Duke of Edinburgh are to visit the R.A.F. Fighter Command station at Leuchars, Fife, on June 4.

Mirage Flies with Rocket

IT is now disclosed that before Christmas—on December 17, 1956—the Marcel Dassault Mirage I delta-wing intercepter made its first flight with its SEPR rocket in operation. A similar rocket had already been tested under the fuselage of a Mystère.

H.P. on Tour

LAST Saturday, January 12, Sir Frederick Handley Page left for New York aboard the *Queen Mary* on the first stage of a seven-week tour of the United States, New Zealand and Australia, during which he will have discussions with military authorities and airline operators.

Silent Frontier

TWO sailplanes, a Slingsby Sky piloted by Claudio J. Dori and a tailless Horten with H. Scheid as pilot, took off recently from San Carlos de Bariloche in the Argentine and crossed the Tronador range at over 9,000ft, landing in Chile some three hours later. This is believed to be the first time the Andes have been crossed by sailplane.

Model Championship Changes

AS a result of recent decisions by the F.A.I. model aeroplane committee, the four world model championships have been grouped into pairs and will be held in alternate years. The glider and speed events are to be in Czechoslovakia from August 15-21, and Britain is to have the option of running the Wakefield and power contests in 1958. With no world championships in Britain this year, the Northern Gala meeting has been brought forward to August Bank Holiday and centralized.

Ubiquitous 500

AN announcement by English Electric, Ltd., says that 500 Canberras have now been built. In addition to being manufactured under licence in Australia and (as the Martin B-57) the U.S.A., the Canberra has been ordered by the air forces of Peru, Ecuador and Venezuela. Lord Caldecote, a director of English Electric, said that there were substantial existing orders which, with others now in prospect, would keep Canberra production going for "several years."

Whirlwind Nigeria-bound

A THIRD Westland Whirlwind is due to be delivered in April to Fison-Airwork, Ltd., and it will go straight out to Nigeria to join the company's two Whirlwinds and two Hiller 360s already operating there on charter to the Shell-B.P. Petroleum Exploration Co. Fison-Airwork have also taken an option on a fourth Whirlwind.

Fighter-to-Fighter Refuelling

THE heading photograph shows two McDonnell Demon fighters testing a new flight-refuelling system developed by Beech. The tanker is carrying a new refuelling store, designated Model 102-G, which is a 22ft-long tank equipped with an hydraulic system capable of delivering fuel at 200 U.S. gal/min. The steel hose is flexible enough to wrap round a reel inside the tank. Capacity of the store is more than 300 U.S. gallons, and refuelling is possible at speeds of more than 350 kt and at altitudes up to 40,000ft.

For Private Pilots

AN informal discussion on private-aircraft topics, organized by the Royal Aero Club, will take place at Londonderry House at 2.30 p.m. on February 15. Representatives of the M.T.C.A., A.R.B. and other bodies will be present; all private-aircraft owners are invited to attend.

Sabre Schoolmasters

THREE West German Air Force training officers, two of them ex-Luftwaffe pilots, have arrived in Canada to study R.C.A.F. methods of training Sabre crews. They will be followed by 360 German airmen who are to be taught by the R.C.A.F. to fly Canadian-produced Sabres. This tuition forms part of the agreement under which West Germany is to purchase 225 Sabres from Canadair, Ltd.

FALCON GAR-1D is the designation of this newest development of the Hughes Falcon air-to-air missile. The picture is also notable for showing—for the first time—the open missile bay of a Convair F-102A intercepter, designed to carry the new Falcon.

ONE-MAN BAND: Recalling a sight not unfamiliar in London streets is this new single-seat Marine Corps helicopter by Hiller, the XROE-1, designed to be collapsed into a package for easy transport or parachute dropping. Weighing less than 250 lb, it is seen here assembled and dismantled. The engine is a four-cylinder Nelson opposed two-stroke.

BRISTOL 192

The R.A.F.'s First Twin-rotor Helicopter: Design Details and Sketches

THE Bristol family of twin-rotor helicopters at present comprises two versions of the Type 173, powered respectively by two Alvis Leonides (550 b.h.p.) and Leonides Major (850 b.h.p.) engines. Following last year's cancellation by the Ministry of Supply of the order for Type 191 machines for anti-submarine duties with the Royal Navy, the next in line is the Type 192, on order for varied duties with the R.A.F.

The 192 is, of course, a derivative of the Type 173, which is essentially a research vehicle for the tandem-rotor configuration, and considerable design changes are likely to be necessary for Service use. The following description, however, indicates the design thinking to date.

Following on from machines powered by Leonides Majors will be versions incorporating Napier Gazelle gas turbines. Another Bristol design-study, mentioned by Mr. Peter Masefield in a recent lecture, is the Gazelle-powered Type 194 which, showing the way to even larger helicopters, would carry 21 passengers, cruise at 160 m.p.h., and have a gross weight of 20,000 lb.

Airframe. Orthodox semi-monocoque construction with light-alloy stringers and frames is used for the 192 fuselage structure, which has a transport joint at the forward front-fuel-tank bulkhead. A duct at the top of the fuselage carries the synchronizing shaft, flying controls and other services; a similar duct carrying other services forms the bottom of the fuselage structure. The inner surfaces of these ducts form the normal skin of the aircraft and the outer covering panels (shaped in the lower duct to minimize ditching pressures) are quickly detachable to facilitate maintenance. Light-alloy castings mounted in the top duct and bolted through the frames carry bearings for the synchronizing shaft and the control rods.

The cockpit incorporates controls and instruments (including blind-flying panel) arranged for the pilot to fly from the starboard seat, with a folding port-side seat for navigator or (when dual controls are fitted) instructor or second pilot. The entrance doors have large moulded windows and are upward-opening and jettisonable. The port side of the fuselage is bulged to permit access to the main cabin (past the front engine and fuel compartment) through a door behind the navigator's seat.

The main cabin comprises the fuselage section between the front engine compartment and the forward fin frame, and is of constant ovoid section. In the bare condition it is 24ft 1in long, 5ft 3in wide and 4ft 11in high. The main entrance, 50in × 54in, is covered by a zip-fastened canvas door (or, alternatively, an upward-hinging metal door carrying winch and searchlight). There is a fixed window on each side of the fuselage and a jettisonable window and escape hatch, 36in × 28.6in, at the port after end of the fuselage. Internal doors give access to the rear engine and, past the forward engine, to the cockpit.

Two bulkheads separate the front fuel tank from the main cabin and the engine compartment. The forward one, together with an auxiliary bulkhead beneath the floor, carries the front undercarriage loads. A port-side passage is formed from the main cabin to the cockpit through apertures in the bulkheads, between the bulged fuselage-skin and the panels enclosing the engine bay and fuel cell.

The front engine is mounted in a near-vertical position. Vertical engine loads are carried, *via* flexible couplings at the base of the engine mounting, by two longitudinal keel members and the forward bulkhead. These keel members extend from the fuel compartment through the engine bay and continue forward to form the main support structure for the pilot's cabin.

The engine is installed and can be serviced through a large aperture in the underside of the aircraft, bounded by the two keel members and the bulkhead at each end of the engine bay. The engine bay as a whole serves as a plenum chamber for engine and gearbox cooling air, which is admitted through an intake on top of the fuselage. The floor structure for the cockpit and forward fuel bay is completed by transverse frames and members.

There are two rear fuel-cells, one situated immediately forward of the rear engine bay and the other aft. The forward bay is enclosed by two main bulkheads, which carry the loads from the rear undercarriage. The rear engine-bay structure and the engine installation is similar to that in the front bay. The rear cooling-air intake is positioned at the top of the fin and provides air for the rear and intermediate gearboxes. Servicing access to the engines, intermediate gearbox, tail structure and the flexible bag-type fuel tank in the rear of the fuselage is provided by an access door in the underside of the rear fuselage. Total fuel-capacity is 560 Imp. gal.

The rear rotor-hub and gearbox are raised high above the fuselage to reduce rotor interference and are mounted on top of the fin, loads being carried by a box structure formed by the three fin spars and the side skin between them. The leading and trailing edges are light, non-load-carrying fairings, the leading edge being detachable for access to the rear-rotor control run.

Structure of the tailplane consists basically of a main spar and a torsion box with stiffened skin, with the addition of a short auxiliary spar at the root end. Behind the main spar, diaphragm ribs support the light-alloy trailing edge.

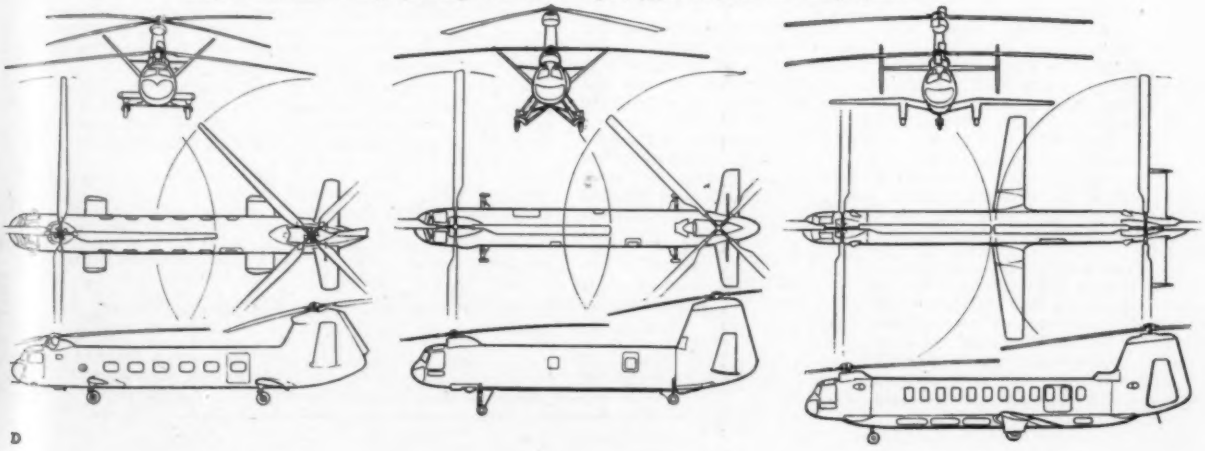
Power Unit. The two Alvis Leonides Major engines each provide 850 b.h.p. under I.S.A. sea-level conditions. The engine is an aircooled radial having 14 cylinders arranged in two banks, the two-throw crankshaft providing a direct drive through a clutch to the transmission system. While the forward clutch is pneumatically operated by the pilot, the aft unit is centrifugal and engages at a predetermined engine speed.

A single-speed centrifugal supercharger is utilized. Accessory drives from the engine include tachometer, Koffman starter and a 4Kw D.C. generator. A Hobson master control unit supplies fuel to the eye of the supercharger impeller. Automatic adjustment of the fuel supply to the engine to compensate for varying engine conditions is obtained with a fuel-metering valve and a boost control valve, which are interconnected to give a single lever control.

Each engine is housed in a removable titanium cowling. The two oil systems are independent, separate oil tanks and oil coolers being located in the front and rear engine compartments. The air intakes are equipped with filters, and by-pass valves permit air to be drawn from the engine bays in icing conditions. Cooling air is provided by a fan mounted on the clutch.

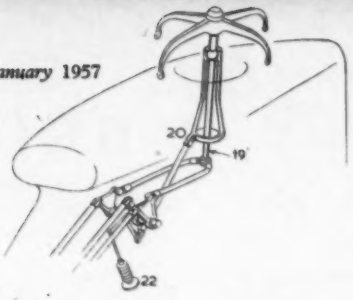
The design of the 192 is such that the Napier Gazelle gas turbine, when available, can be installed in place of the Alvis

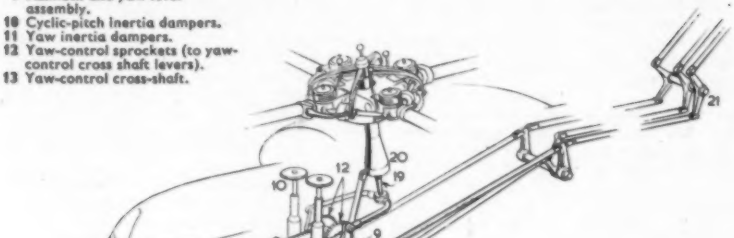
Bristol's twin-rotor family: (reading from left to right) Types 173, 192 and the projected 194.



BRISTOL 192 . . .

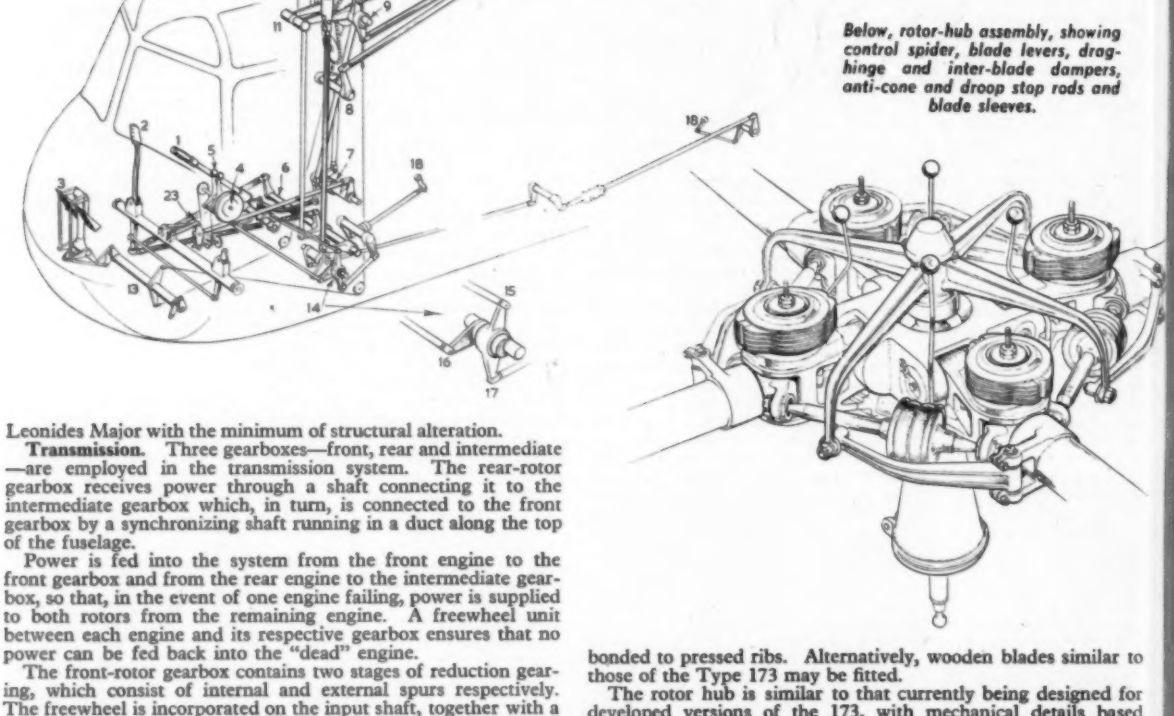
1 Collective-pitch control stick.
2 Cyclic-pitch control stick.
3 Yaw-control pedals.
4 Hand trim-wheel.
5 Hand throttle-levers.
6 Cyclic-pitch cross-shaft.
7 Eccentric torque-shaft (collective and mixing).
8 Collective-pitch cross-shaft.
9 Azimuth and yaw lever assembly.
10 Cyclic-pitch inertia dampers.
11 Yaw inertia dampers.
12 Yaw-control sprockets (to yaw-control cross shaft levers).
13 Yaw-control cross-shaft.
14 Eccentric levers (engine controls).
15-17 Engine control rods.
18 Engine control levers.
19 Articulating joint.
20 Collective-pitch sleeves.
21 Reversing levers.
22 Inertia damper.





Control system of the Bristol 192. The engine-control eccentric-lever detail (item 14) is typical of many of the control assemblies.

Below, rotor-hub assembly, showing control spider, blade levers, drag-hinge and inter-blade dampers, anti-cone and droop stop rods and blade sleeves.



Leonides Major with the minimum of structural alteration.

Transmission. Three gearboxes—front, rear and intermediate—are employed in the transmission system. The rear-rotor gearbox receives power through a shaft connecting it to the intermediate gearbox which, in turn, is connected to the front gearbox by a synchronizing shaft running in a duct along the top of the fuselage.

Power is fed into the system from the front engine to the front gearbox and from the rear engine to the intermediate gearbox, so that, in the event of one engine failing, power is supplied to both rotors from the remaining engine. A freewheel unit between each engine and its respective gearbox ensures that no power can be fed back into the "dead" engine.

The front-rotor gearbox contains two stages of reduction gearing, which consist of internal and external spurs respectively. The freewheel is incorporated on the input shaft, together with a spiral bevel for the synchronizing shaft. The intermediate gearbox contains a pair of spiral bevel gears. Auxiliary drives for two alternators and an oil pump are taken through bevel gears, and the freewheel is fitted to the input side of the intermediate gearbox. The rear gearbox incorporates two stages of reduction gearing, comprising a first-stage spiral bevel gear and a second-stage spur gear.

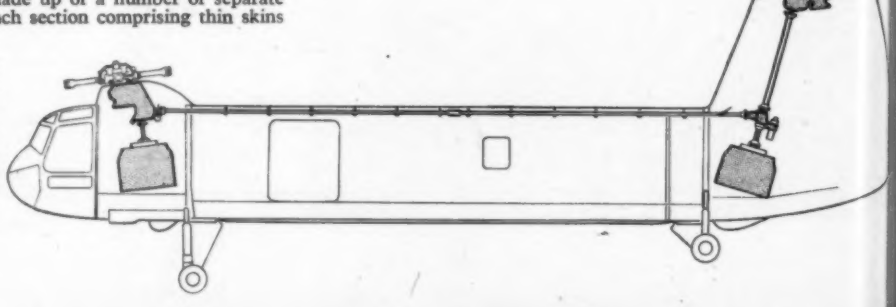
Oil from the supply tank is circulated to front, rear and intermediate gearboxes by means of pressure pumps in the intermediate gearbox. Circulation is completed by a scavenge pump in the front gearbox and by gravity from the rear and intermediate gearboxes. A hydraulically operated rotor-brake is fitted at the forward end of the synchronizing shaft.

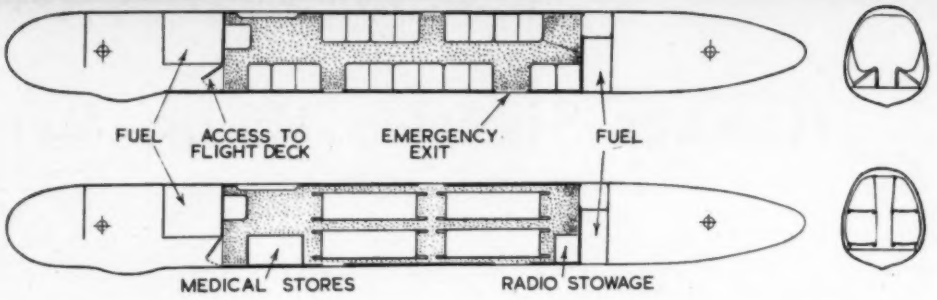
Rotor Hub and Blades. Light-alloy construction is used for the constant-chord blades, each of which incorporates an extruded hollow D-section combined leading edge and spar. Aft of the spar the blade is made up of a number of separate sections bonded to the spar, each section comprising thin skins bonded to pressed ribs. Alternatively, wooden blades similar to those of the Type 173 may be fitted.

The rotor hub is similar to that currently being designed for developed versions of the 173, with mechanical details based on the hub design used on the 171 and 173 prototypes, and is illustrated in the sketch above.

Each rotor hub consists of a driving hub to which blade sleeves are attached through flapping and drag hinges. Centrifugal loads are transmitted from the blades to the drag hinges through tie rods, which are constructed in eight segments to provide low torsional stiffness. Blade root bending loads are taken on light journal bearings, and drag-hinge and inter-blade dampers are fitted. Cyclic-pitch control is obtained by tilting a centrally mounted spider, and collective pitch is controlled by vertical movement of a cone carrying the spider in a spherical seating. Centrifugally operated droop and anti-coning stops are fitted, to prevent blade sailing and excessive droop during starting-up and running-down in high and gusty winds. Operated by bob-weights restrained

Transmission layout of the 192 follows 173 practice. The synchronizing shaft runs between the front and intermediate gearboxes, engine shafts to front and intermediate gearboxes respectively, and rear rotor shaft between intermediate and rear gearboxes.





Alternative layouts of the machine for (top) troop-carrying (18 seats plus despatcher) and ambulance rôles.

by springs, these stops are actuated by a stepped-cam mechanism and engage with the blade links. Disengagement takes place at about 120 rotor r.p.m., and the stops engage again when the rotors slow down to 80 r.p.m.

Controls. The basic flight-controls consist of the pilot's cyclic-pitch control column, the central collective-pitch control lever, and adjustable rudder pedals. The collective-pitch lever is linked to the engine throttle so that the rotor r.p.m. remain approximately constant as collective pitch is increased. Throttle adjustment can also be made by a twist-grip on the collective-pitch lever, and hand throttles are provided for independent control of each engine.

Secondary controls comprise an electrically operated pitch trimmer to compensate for varying c.g. positions, and a rudder bias control to trim out pedal loads.

Fore-and-aft control is obtained by the application of an equal amount of cyclic pitch to both rotors together with differential application of collective pitch. Thus in moving the control stick forward both rotors are tilted forward and, simultaneously, the front-rotor collective pitch is reduced and that of the rear rotor increased. This combined control is designed to give a satisfactory combination of linear and pitching acceleration.

Yawing forces are obtained by movement of the rudder pedals which causes lateral tilting of each rotor by equal amounts but in opposite directions. Lateral control is provided by lateral movement of the control stick, causing both rotors to tilt laterally by the same amount and in the same direction. Collective-pitch stick movement gives an equal change in the collective pitch of both rotors.

Power assistance is provided by small servo motors in the fore-and-aft cyclic-pitch, yawing and collective-pitch control systems, and an automatic pilot can be fitted. By means of a master switch on the collective-pitch lever, all servos and the autopilot (if fitted) can be disengaged simultaneously.

Undercarriage. The landing gear, designed for vertical landing velocities of 8ft/sec (normal) and 12ft/sec (emergency), comprises two units equally spaced fore and aft of the aircraft c.g. to give a wheelbase of 30ft and a track of 10ft.

The configuration of each unit is conventional in that each consists of inclined oleo legs with radius rods in the form of torsion boxes. The inboard ends of each pair of torsion boxes are coupled together by means of a swinging link which in turn is attached to an air/oil strut operating as both a spring and a damper. Fully castoring wheels are incorporated in the front unit, the direction of the rear wheels being fixed.

Electrics. Two 4kW, 28v D.C. generators are employed, one being driven from each engine, and provision is made on the intermediate gearbox for two alternators, each with an output of up to 9kW. The capacity and voltage of the alternators will depend upon electrical requirements.

Estimated Performance. Calculations of the performance of the 192 in the rôles of troop-carrying, casualty evacuation, freighting, search and rescue, and parachuting and supply-dropping are given below. Two basic types of operation have been considered: in the first the cabin load is restricted to obtain maximum range; in the second the maximum possible load is carried over short distances.

Troop-carrying. As illustrated, the normal troop-carrying accommodation provides for a pilot, co-pilot or navigator, and 18 passengers (long-range operations). For short-range operations, 22 troops each weighing 250 lb, or 25 at 200 lb, could be carried. Passenger seats are of the folding deck-chair type with tubular framework and are removable.

Under sea-level I.S.A. conditions, 18 troops could be carried for 100 n.m. (cushion take-off to 20ft) or 14 troops for 190 n.m. (vertical climb outside ground cushion), allowing 10 gal of fuel for warm-up and take-off. For short-range operation, 22 or 19 troops (depending on the same respective take-off techniques) could be carried over 25 n.m., with reserve fuel for 14 minutes' flying at economical cruise in addition to the ten-gallon take-off reserve.

Casualty Evacuation. The ambulance version of the 192, illustrated above, provides accommodation for pilot, co-pilot or navigator, medical attendant and eight stretcher cases. The vertical distance between stretchers in this arrangement is 28in. By reducing this separation, the stretchers could be mounted in tiers of three, increasing the number to 12. In addition, accommodation for three "sitting wounded" cases could be provided on troop seats, giving a total of 15.

Under I.S.A. sea-level conditions, 12 stretcher cases and three sitting casualties could be carried over ranges of 360 n.m. (cushion take-off) and 275 n.m. (vertical climb outside ground cushion).

Freighting. The maximum distributed load that could be carried in the cabin is 6,000 lb, and the maximum concentrated load is 5,250 lb (with a limit load factor of 2g) or 4,000 lb (with a limit load factor of 3g). Maximum floor loading is 75 lb/sq ft, and lashing-down points are fitted to the cabin floor, which is level throughout. Crew accommodation is provided for a freight operator in addition to the pilot and co-pilot or navigator.

Freight can be loaded and unloaded through the main entrance door, 50in wide × 54in high, and the escape hatch at the port after end of the cabin, 28½in wide × 36in high. By substituting a door carrying a winch (as in the search-and-rescue rôle) in place of the normal canvas door, freight up to 600 lb per hoist could be raised and stowed, or lowered, with the aircraft hovering. Awkward loads which cannot be carried in the cabin could be slung externally from a strong-point under the fuselage, pilot-operated electrical and mechanical release mechanisms being incorporated, up to the same maximum as for concentrated loads in the cabin.

Long-range performance figures under sea-level I.S.A. conditions include 3,500 lb load for 300 n.m. (cushion take-off) or 210 n.m. (vertical climb outside ground cushion). Short-range performance under these conditions comprises 5,745 lb or 5,045 lb respectively, over 25 n.m.

Search and Rescue. The main innovation for the rôle of search and rescue is that the canvas entrance door is replaced by a metal door carrying an electrically operated winch capable of hoisting a 600 lb load at 3ft/sec, and also carrying a searchlight. The door is spring-balanced and can be opened and closed in flight. The operation of the winch is controlled either by the pilot, by means of a switch on the cyclic control column, or by the aircrewman by means of a switch located near the door.

Ten persons could be rescued at a radius of action of 210 n.m., under sea-level I.S.A. conditions and at a take-off weight of 16,200 lb. This assumes reserves of 20 per cent of total fuel carried on take-off, and 20 minutes at maximum power while hovering. At shorter ranges more than ten could be rescued, but fuel would have to be jettisoned as necessary to bring the gross weight down to that at which the machine could hover without ground effect.

Paratrooping and Supply-dropping. For the parachuting of personnel or supplies, a static line is secured to the strong points near the main door, and a non-skid mat is used. Despatching lights are located above the entrance door.

Under sea-level I.S.A. conditions, 12 paratroops could be carried for 250 n.m. (cushion take-off) or 170 n.m. (vertical climb outside ground cushion); under the same respective conditions 17 or 15 could be carried over 25 n.m.

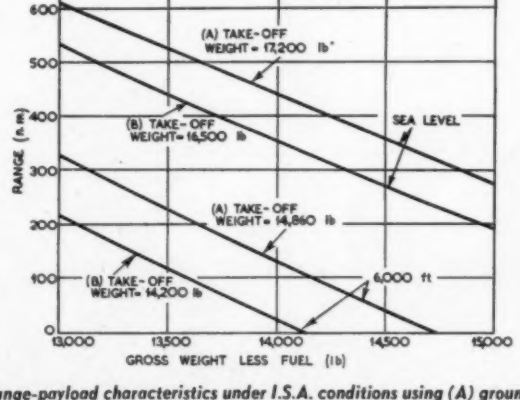
Bristol 192 (2 Alvis Leonides Major): Leading Data

General: Maximum gross weight, 17,200 lb; disc loading, 4.57 lb/sq ft; nominal power loading, 10 lb/b.h.p.

Major dimensions: Overall length (blades folded), 54ft 4in (max 89ft 9in); distance between rotor centres, 41ft 1in; maximum height (blades folded), 17ft; undercarriage track, 10ft; undercarriage wheel base, 30ft; main cabin length, 24ft 1in; main cabin height, 4ft 11in; main cabin width, 5ft 3in.

Rotors: Diameter, 48ft 8in; aerofoil section, NACA 64_1-012; chord, 15½in; disc area per rotor, 1,860 sq ft; gear ratio (engine to rotor), 12 : 1; maximum rotor r.p.m., 270; maximum tip speed, 687ft/sec.

Napier Gazelle version (two NG.2s, each of 1,650 s.h.p.): gross weight, 18,000 lb; cruising speed, 115 m.p.h.; ceiling, 14,000ft; range, 450 miles.



Range-payload characteristics under I.S.A. conditions using (A) ground-cushion take-off and (B) vertical-climb take-off outside ground cushion, at 80 kt cruising speed.

Hawker Siddeley Happy Returns

Points from Sir Thomas Sopwith's Speech at the Group's 21st Annual General Meeting

IN his report to the 21st annual general meeting of the Hawker Siddeley Group, Ltd., at the Dorchester Hotel, London, on Wednesday of last week, the chairman, Sir Thomas Sopwith, made special reference to the achievements of the past twenty-one years. During that period, he said, the group companies had produced over 44,000 aircraft, including 13,000 Hurricanes, more than 8,000 Ansons, 5,000 Lancasters and over 3,500 Meteors.

Sir Thomas went on to describe as "the largest single factor" in the growth of the group its venture into Canada. A. V. Roe Canada, Ltd., formed in 1945 with only 300 employees, had in the last eleven years become one of the Dominion's major industrial units, employing some 20,000 people.

The group had had another satisfactory year's trading, both here and in Canada, and its profits for the year ended last July amounted to £12,847,867, before taxation, compared with £12,675,537 for the previous year. Of the 1956-57 profit, over £6 million was contributed by Canadian members of the group.

Referring to some of the group's achievements during the year under review, the chairman told shareholders that his Board were confident that the Armstrong Whitworth private venture turbo-jet civil transport would meet a world-wide need, and said that airline companies all over the world had asked to be kept informed of its development. [More news of the A. W. Freightliner appears on pages 66-67 of this issue.]

Big investments had been made both at home and in Canada to provide the technical facilities "without which it is impossible to survive in this fast-moving technical world." As a result, Armstrong Whitworth Aircraft were expanding their research facilities at Whitley; a self-contained research establishment for Armstrong Siddeley Motors was nearing completion; Avro research and development facilities were being expanded; new premises were being built by Hawker Aircraft to house increased design and research staff; and in Canada there had been considerable expansion both to Orenda Engines' test facilities and at Canadian Steel Improvement, Ltd.

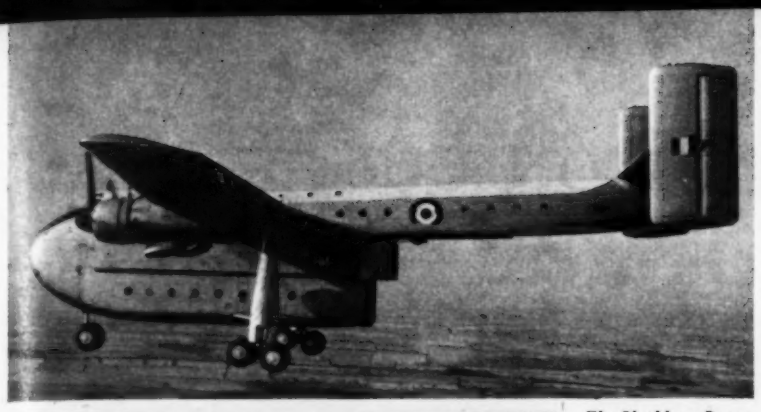
Speaking next of guided-missile progress, Sir Thomas reported that practice-firing missiles designed and built by A.W.A. had been fired from H.M.S. *Girdle Ness*, that ordinary flight testing had increased and that the Australian unit had proved valuable.

On research into nuclear power, he spoke of progress made by the Hawker Siddeley Nuclear Power Co., Ltd., in their studies of certain nuclear reactor systems "and especially of the liquid metal fuel type of reactor."

Turning to aircraft and aero-engine progress over the past year, the chairman said that Vulcan production was now in full swing but development was still proceeding. Delivery of Hunters to Denmark and Peru had been completed and progress made towards fulfilment of the larger order from Sweden. Production of the Javelin 1 had been completed and later versions were well established on the production line. Armstrong Siddeley turbojets and turboprops were now flying in 23 types of military aircraft here and overseas.

Sir Thomas finally referred, in his remarks on Air Service Training, Ltd., to the shortage of trained pilots in British civil aviation. He said that the Ministry of Transport and Civil Aviation still did not recognize the necessity for embarking on a properly planned training scheme for pilots to ensure a supply of competent civil airline captains, and that British airline corporations were now seeking recruits in Canada, Australia and New Zealand. Unless some system—such as the provision of training grants—to help pilots to train from the initial stages were established in this country, the same difficulties would recur.

At the 21st annual general meeting of the Hawker Siddeley Group (reported above) it was stated that production of the Avro Aircraft CF-100 continues on schedule and that the development of the CF-105 two-seater supersonic delta is making satisfactory progress. This new full-face close-up of a CF-100 does justice to the sturdy Canadian character of this all-weather long-range intercepter.



The Blackburn Beverly C.1 is seen in its heavy-dropping guise, without rear doors and with airflow stabilizers fitted. A design-study for a turboprop development of the Beverley is in hand.

The Grumman TBM Avengers on the left belong to the Japanese Maritime Self-Defense Force.

AIRCRAFT INTELLIGENCE

U.S.A.

Cessna 310. This efficient light twin has been awarded the first of the U.S.A.F. Air Materiel Command's "off-the-shelf" contracts, which are to be placed whenever the Air Force finds that a requirement can be met by an existing aircraft. The Wichita firm have received a $5 million contract for 80 Model 310s, which the U.S.A.F. will use for liaison and light cargo work.

Grumman WF-2. This is the designation of a new early-warning variant of the S2F Tracker (which is now the U.S. Navy's standard carrier-based anti-submarine aircraft). The WF-2 carries a large dish-like radar installation, similar to the experimental equipment on a U.S. Navy WV-2 (*Flight*, August 17, 1956).

Lockheed F-104B. Making its maiden flight at the beginning of the year was this tandem-seat variant of the basic F-104 Starfighter. The F-104B is the subject of major programmes at Lockheed's California and Georgia divisions and is in production for the U.S.A.F. The lower-powered and shorter XF-104 experimental Starfighter has now completed 500 flights and logged more than 350 hr since it first flew three years ago.

North American FJ-4B. Reported in an earlier issue, this development of the basic FJ-4 Fury has been evolved specifically for low-altitude attack operations. The control system has been substantially revised in all three axes and the structure has also been somewhat altered to allow the aircraft to operate at extremely high indicated airspeeds at very low altitudes. Among the equipment carried is a special low-altitude bombing system. The FJ-4B is powered by a Wright J65 Sapphire turbojet, like its predecessor the FJ-4, and is succeeding the FJ-4 in production at North American's Columbus, Ohio, division. The first FJ-4B made its first flight at the end of last year.

France

Nord 1500 *Griffon.* Flight trials of the first prototype of this curious canard supersonic fighter have temporarily ceased while the aircraft is back in the factory undergoing extensive modification. The ultimate form of ramjet is being installed as a booster to the Atar turbojet, both units sharing a common intake under the forward fuselage. The second Griffon is at present being assembled at Istres and should start flying within the next few weeks.

Bréguet 1050 *Alizé.* The first flight of the second prototype of this anti-submarine aircraft (Rolls-Royce Dart) took place at Toulouse on December 21. The 1956 procurement programme covered the production of fifty of these machines.

Bréguet 1100. Powered with two Turboméca Gabizo turbojets, this light fighter, to an official French specification, has now been completed at Villacoublay. It is being transported to Istres for its first flight.

Austria

*O.K.*15. The prototype of the O.K.15, the first aeroplane designed in Austria for 20 years, has now begun its flight trials. A low-wing, side-by-side two-seater, this machine is powered by a Walter Minor III and should cruise at about 124 m.p.h. It is manufactured of metal, wood and fabric and has been built by the Austrian Aircraft Factory at Wiener Neustadt.

SIKORSKY HR2S-1W
(Two Pratt and Whitney R-2800)

Rotor diam.	72ft
Fuselage length (estimated)	69ft 6in

THE PRODUCTION CONFERENCE

Some Notable Papers and Discussions at Southampton

THE Institution of Production Engineers' conference on *Problems of Aircraft Production* has, in only five years, established itself as one of the best-organized events of the aeronautical year. Officially it is the prerogative of the Southern Section of the I.P.E., but in fact it is representative of the activities of the aircraft industry (and its ancillary suppliers) as a whole; and as such it provides a significant cross-section of the production aspect of current activities.

The scene of this year's conference, on January 8 and 9, was, as always, the University of Southampton—a venue due to the moving spirit of Professor E. J. Richards, that most energetic head of the Aeronautical Engineering Faculty there. True to tradition, the secretary of the I.P.E., Mr. W. F. S. Woodford, and Miss M. S. C. Bremner, the editor of its *Journal*, had printed copies of each paper, together with a programme and a most useful personal identification tab, ready and waiting for each delegate.

The proceedings opened at an official lunch attended by the Minister of Supply, the Rt. Hon. Reginald Maudling, M.P., and the Mayor of Southampton, Mrs. K. E. Cawte, J.P. The chairman of the Southern Section of the I.P.E., Mr. D. L. Wigg.ns, welcomed the guests, headed by Dipl. Ing. Karl Frydag, the author of the Lord Sempill Paper.

The Lord Sempill Paper

Introducing DIPL. ING. KARL FRYDAG, LORD SEMPILL said he had known him since, in the 1920s, he had been concerned with the Rohrbach Romar. Thereafter he had worked with Messerschmitt and Focke-Wulf before joining the Henschel Flugzeugwerke—the greatest German "shadow factory" of the war—with whom he stayed until Germany's collapse in 1945. Now he was a director of the parent company Henschel und Sohn of Kassel, which employed ten thousand.

Dipl. Ing. Frydag opened his paper *Concentration of Aircraft Development* by saying that in 1928 the 20-ton Romar all-metal flying-boat was designed in five months by some eighty engineers and that in another five it was flying. Last year Sir Roy Fedden had told the conference that an American firm estimated that "an astronomical number of engineers" would require five years to evolve an Atlantic airliner at a cost of nearly thirteen million pounds. Only engineers of the very first class could do this work and they were in extremely short supply. Therefore, it was essential for every country to realize it was faced with three main requirements: (a) comprehensive long-term planning based on a complete, careful analysis of all contemplated development; (b) concentration upon a limited number of projects; (c) strict adherence to the selected projects and their developments to the utmost of their possibilities."

The parallel often drawn between a European country and the U.S.A. was unfair because the latter was a continent with far vaster means and manpower, and no single country could keep pace. However, the country which concentrated could compete and lead the world—as Britain did with the Viscount and Comet. It was basically wrong to say: "Buy your aircraft in the U.S.A. and save the excessive expense of research and development," for this ignored European achievements—which had been outstanding in many fields. Out of aeronautical research came benefits for a country's whole industry. The need was to co-operate as well as to specialize, so as to conserve the technical effort.

"Western Europe," continued the lecturer, "is producing each year approximately 12,000 engineering graduates. Great Britain alone is producing 2,800 a year. The U.S.A. produced in 1950 50,000 engineering graduates which (astonishingly) decreased to 22,000 in 1955. Russia, however, produces at the present time 60,000 engineering graduates every year. These figures convey a grave warning to us. . . . In the above figures I have not included China; but this country as well will have available, in some decades, a great number of engineering graduates."

Dipl. Ing. Frydag went on to say that the "neutral visitor" to the S.B.A.C. Display was astounded to see the numerous fields covered by the British aircraft industry and he considered that no country of this size could successfully complete so many projects, adding: "One should not forget that the development of prototypes alone will not do, and successful production swallows colossal sums in capital." It was no good to finish an aircraft "some day," it must be ready at the planned date—before it was obsolete. He considered that, had Germany after 1933 had as varied a programme as Britain today, she would never have achieved substantial production.

The German programme "had been planned ahead in full detail by a small number of very qualified engineers and by members of the *Luftfahrtministerium* and comprised development of only: two fighters; one night fighter; two bombers; and three engines, 35- and 48-litre liquid-cooled and one air-cooled."

This programme was supported by meticulous planning, from research to material supply, and including the establishment of one standard drawing system. Design was concentrated in seven airframe and three engine companies, backed by a number of private-enterprise mass-production firms—financed through a special State bank. These works were all built to a precise output in the overall scheme; e.g. the Henschel factory (which Dipl. Ing. Frydag managed from the time it was a grass plot until it was taken by the Russians in 1945) was to build 100 twin-engined bombers a month. Tooling, particularly in the provisioning of presses, was very complete, with many automatic machines. Every factory achieved its planned output while its production plan remained unaltered, i.e. until the end of 1941 and the beginning of 1942.

"Then came the tragedy," for when the *Luftwaffe* lost its air superiority and the R.A.F. penetrated into Germany, the military became nervous and interfered with production, occasioning constant switches of almost the whole programme; at first the Me and then the Fw fighter was considered the better. Dipl. Ing. Frydag particularly instanced the disorganization caused by cancellation of the Me210 (410), because of development snags, after production was actually under way in five countries. Henschel had spent 1,000,000 man-hours on tooling for a 100-a-month output by unskilled labour.

At this point Dipl. Ing. Frydag showed a film that revealed the astounding degree of mechanization achieved. The item was a centre-section spar of conventional I-section, composed of web plate and booms built up from angle extrusions and cap plates, the spar having considerable dihedral. The fixture was a form of bench into which the plates and angles were assembled by girls and which were hydraulically clamped by remote control. End fittings were put in place, held apart by bracing plates between upper and lower booms and then drilled, in one operation, by multiple drill-heads. Other fitting locations were similarly drilled by multiple heads as a single operation—followed, where appropriate, by multiple reaming. The top number of drills in one multiple head was 140.

The boom-assembly drilling, countersinking and riveting were done by automatic travelling machines—this in both planes in successive passes. The only manual operation was the hurried insertion of the rivets in front of the moving heads by a girl (there was said to be an infra-red safety device). The pitch of the rivets was set by a castellated guide-plate under the fixture and was not incorporated in the machine itself. Drill guide-plates were used only for the multiple reaming operations.

The speaker considered that an error was made in trying to build the Me262 without first cancelling one of the other fighters. By the beginning of 1944 production was barely 2,000 aeroplanes a month, but in March the programme was rigorously pruned, with the result that by September it had risen to 4,800—the best proof that type-limitation was the key to productivity.

Pointing his moral from history, Dipl. Ing. Frydag maintained that the same lesson was true today. An aircraft industry should be jointly controlled by government and industry. Technical progress was so rapid that a governing board must be of the highest quality to select the right types and to distribute the work correctly.

"All of us," he continued, "will have to defend Europe and I do not think that the current development in Great Britain will meet the requirements of NATO. The ten post-war years show in Great Britain developments covering fully almost any field you can think of, and this country is wasting its resources because of the diversity of its projects."

Dipl. Ing. Frydag added that, like Sir Roy Fedden, he believed in concentration of the industry into a few large units. The production engineer must be given a higher status and be allowed to play a much greater part in the aircraft industry of the future—as he was today in the U.S.A.

Answering his own criticisms, the lecturer suggested that the British aircraft industry's programme should be: to consolidate and maintain its turbine-engined-airliner lead; to build two fighters, an intercepter and a supersonic long-range design; to develop a supersonic bomber, licensing a "conventional night bomber" (*sic*) from America; and to co-operate with Europe and the U.S.A. in the very wide field of guided weapons by contributing one type.

Thanking the speaker, SIR ROY FEDDEN said he thought that the troubles instanced should even more bedevil today's more complex aircraft. He noted what an improvement there was in the U.S. scene as a result of the rationalization following the Findlater Report, which had been called for by President Truman in 1947. He hoped we could likewise take a few stitches in time.

Seconding, MR. T. GILBERTSON, director and general manager of Folland Aircraft, Ltd., said he "wished to goodness someone would be enough of a dictator to standardize a drawing system in this country." The Henschel film would send people away thinking of the wicked waste of mild steel thrown away in jigs. Ninety per cent of such extensive tooling effort, e.g., drilling heads, is not wasted in this type of manufacture. Production engineers for the future must be drawn from the most intelligent of the coming generation, whereas at present the tendency is to channel the best brains toward research and development.

Session II, under the chairmanship of PROFESSOR E. J. RICHARDS, consisted of one paper, *The Fatigue of Aircraft* by MAJOR P. LITHERLAND TEED of Vickers-Armstrongs (Aircraft), Ltd. Instead of reading through his printed paper, Maj. Teed gave an "off-the-cuff" discourse, from a typewritten text, in his own puckish style.

He started by making a series of appeals. To the designer he suggested two precepts: design to fail safe and where this is impossible aim for a long fatigue life. To the operator: avoid repeated loads by flying high and using smooth runways. To the pilots: adopt a policy of slow descents—a rapid let-down is like driving fast over a rough road. To production engineers: concentrate upon surface finish, residual stresses, built-in stresses, and metallic structures, "both micro and macro." Since the surface was always the most highly-stressed area this was the most important and fortunately it could be well controlled. Built-in stresses could be avoided by the use of shims and other methods of avoiding tight fits—in which connection it was worth noting that the ball in a bearing was the only truly axially-loaded part in the world.

Every rivet or bolt in the million in a modern aeroplane was a source of several stresses, which was one good reason for using larger integral components.

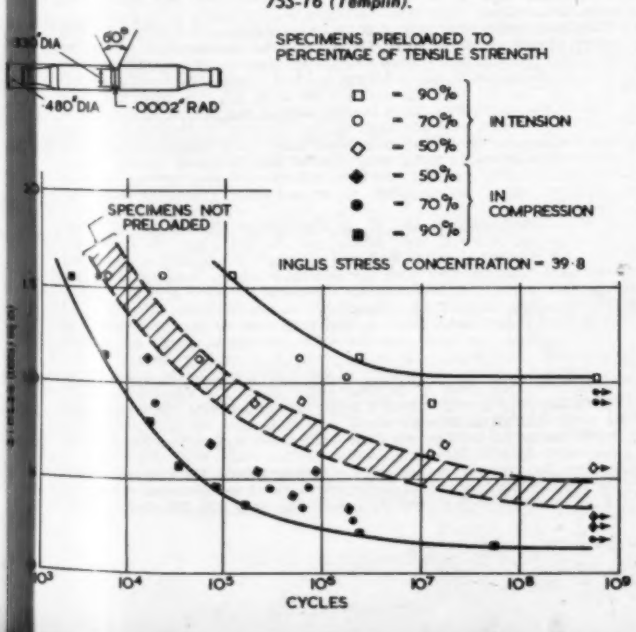
Discussing the effects of heat treatment and machining, Maj. Teed made the point that metals reacted to the algebraic sum of the stresses imposed upon them. The influence of residual stresses induced by plastic deformation on the fatigue resistance of a notched wrought aluminium-alloy test-piece was shown by a slide (Fig. 1). Having been pre-loaded in tension, the test-piece had a residual compressive stress at the base of the notch, thereby increasing fatigue resistance. Pre-loading in compression, producing a residual tension on test, the fatigue life is considerably reduced. An R.A.E. test had similarly shown that the application of a load well beyond the elastic limit every 20,000 cycles had extended the fatigue life of a wrought aluminium-alloy part tenfold.

In response to a question by MR. J. GREGSON (Fairey) the speaker said that machining after heat treatment could be very beneficial by engendering residual tensile stresses in a component.

MR. J. C KING (English Electric) quoted the case of a forked fitting which fitted over a plate and which developed stress-erosion cracks between adjacent attachment bolt-holes. These cracks started on the inner faces, and by inserting a thin spacing foil between lug and web it had been possible to apply a strain-gauge between a pair of holes, from which it was learned that the *mean*, not peak, stress was as high as 20,000 lb/sq in when the bolts were tightened. This was due to local bending stresses caused by unevenness under the bolt heads. Offering this experience for the general benefit, the questioner asked how the speaker dealt with such incidents. Major Teed replied that the technical office advised on methods—probably after trouble had occurred!

In response to other questions, the speaker said that the B.S.I. was slowly improving the definitions for surface finish. Electrolytic finish gave the best polish, but was bad for fatigue, since it did not resist stresses well. Metal near its melting point usually failed along the inter-crystalline boundary, whereas when it is several hundred degrees below its melting point it fractured across the crystal. A corrosive atmosphere bleached out the boundary, so causing the crack to start (unnaturally) in this zone—this phenomenon was prevalent in the aluminium-zinc alloys.

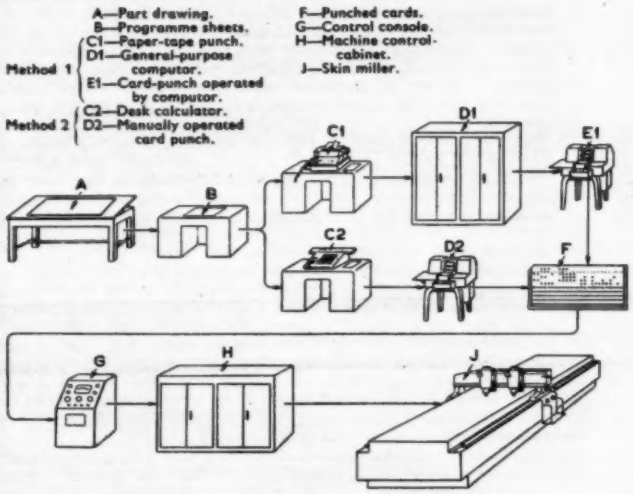
Fig. 1. Effects of internal strain on the rotating-beam strength of 75S-T6 (Templin).



Session III consisted of a lengthy paper entitled *Numerical Control of Machine Tools in Aircraft Manufacture*, by MR. O. S. PUCKLE of E.M.I. Electronics Ltd. This speaker chose to read his paper out of its printed order, and he showed few of the slides which amplified the text, so that it was less informative than it could have been.

"Numerical control" is a term which originated at the Massachusetts Institute of Technology and means that a machine is controlled by the injection of numerical position information, which acts through suitable servo-motors and valves upon the more or less normal machine parts. There are two basic methods: the digital and the analogue. The former can be said to control by incremental dimensions and the latter by positional sensitivity. The drawing information is converted into programme sheets, from which it is then converted into tape or card information (Fig. 2). In effect, numerical control replaces the elaborate machining fixtures and/or the progressive measurement of parts. E.M.I. is currently developing control systems for integral wing structures, wing spars and ribs, turbine blades and ship propellers. Turbine blades, with their development system of mathematical expressions for the aerofoil ordinates, are well-suited to programming. As an example of accuracy, E.M.I. expects that its system used with a Cincinnati skin miller should be of the order of 0.010in in the *x* axis for the full length of the table and 0.002in in the *z* (vertical) axis. There is an agreement whereby E.M.I. is to provide numerical controls to Cincinnati for its Hydrotel and other appropriate machines.

Fig. 2. Numerical control system for Cincinnati gantry-type miller



The E.M.I. analogue control gives the discrete dimensional drawing information to the machine in the form of successive tool positions with an interpolation process to ensure a smooth curvilinear motion. The control cabinet signals have output voltages which give continuous analogue representation of the required work. Feedback loops provide a constant check upon the relative positions of tool and work. By a device in the cabinet which continually computes the normal to the curve being cut, automatic compensation for cutter wear can be provided. Mr. Puckle said that such compensation could not be achieved with digital control.

For his replies Mr. Puckle was joined by MR. R. H. BOOTH, technical manager of the industrial applications division of E.M.I. Engineering Development, Ltd.

MR. H. H. CHAMBERS (Rockwell Machine Tool Co., Ltd.) saw an application to the making of forging dies and thereby an increase in the use of forging presses. What happened with a blunt cutter and what occurred when a cutter met a sharply rising curve? Mr. Booth said that although cutter wear could be compensated, a deterioration in finish

THE PRODUCTION CONFERENCE . . .

might be the criterion. It was possible to code cutter regrinding or replacement into the control tape. The machine would slow down as it met a gradient. At present the control operated in three dimensions, but four or five were quite feasible.

MR. R. S. BROWN (Bristol) asked how, as it was difficult to buy U.S. machine tools, it would be possible to use the E.M.I. control. Could the British machine tool industry make tools suitable for use with it? Three British companies were already doing so, said Mr. Booth: Research Engineers, Wadkin, and the British Cincinnati. The S.B.A.C. was, furthermore, always willing to specify requirements to the British Machine Tool Association. A skin miller for use with the analogue control was under construction.

The Second Day

The second day consisted of a tight-packed morning programme of three papers on actual manufacturing methods, taken at a rattling pace by MR. S. P. WOODLEY (Vickers-Supermarine). The time available necessitated condensation of two of the three interesting papers, which were taken in succession in an hour and a half with a composite discussion at the end.

Of MR. R. G. WILKINSON, development manager of Magnesium Elektron, Ltd., it might have been said that he took as his text: "If you know how to use it, it is a marvellous material." In Britain wrought magnesium products had always averaged less than 10 per cent of the total for engineering purposes, while in the U.S. it was 30 per cent—with a peak of 50 per cent in 1950 when the Convair B-36 was in full production. This aeroplane used about 7,500 lb of magnesium sheet. The crystal structure of magnesium limited its capacity for cold deformation and any major forming must be done between 230 and 350 deg. C. Once the inconveniences associated with hot handling had been accepted, said the speaker, numerous advantages were to be found. Generally, greater deformation could be achieved in one pass than with other materials; power requirements were less; dimensional accuracy was good, because of low spring-back; dimensional control could often be achieved by tool and material temperature adjustment. Cold forming was possible, but was restricted to simple bends of large radius; while, on the other hand, operators soon got the "feel" of preheating sheet with a blowtorch. The use of magnesium-alloy tools for small batches of press work gave good wear and obviated the need for temperature differential allowances. In stretch forming, essentially a tension process, the working temperature range was between 130 and 180 deg. C.

Properly used, magnesium and its alloys were not subject to excessive corrosion. It was used, unprotected, in the Volkswagen car and in guided weapons, which might be stored for long periods under poor conditions. The latter case had led to the replacement of chromate treatment by, in the U.S.A., the H.A.E., CR-22 and Dow 17 electrolytic treatments, and in this country by the fluoride anodizing and Higgins's surface sealing processes. Because it was notch-sensitive, riveted and bolted joints in magnesium had to be very carefully designed; but it could be successfully Argonarc- or spot-welded.

The author showed a curve suggesting that certain magnesium alloys maintained strength well into the "thermal barrier" range. HK 31, an American magnesium-thorium alloy compared favourably with the aluminium alloys up to 315 deg C, while an even better British alloy was on the way which had a Young's Modulus of 5.3 at 300 deg C and 5.5 at 250 deg C. The correct way to use magnesium was to take advantage of the stiffness possibilities.

MR. N. K. GARDNER'S paper, *Recent Advances in the Application of Resistance Welding to Airframe Construction* was also, unfortunately, read in brief, despite the considerable informativeness of the full text. Only four years ago, he said, an eminent aircraft designer had said at this conference that "stiffness could never be spot-welded into the skin." Today Boeing, Grumman, Handley-Page and Sud-Est Aviation were using resistance welding for primary structures (Mr. Gardner is with Handley-Page).

Out of 300,000 welds radiographically examined in Victor production only 2-3 per cent were defective—and this was principally due to poor mating of parts. He considered that flash-butt welding, much used for joining light-alloy fork-ends and tubes, provided one of the few methods of joining titanium without inert gases, and it gave a magnesium weld of 100 per cent efficiency.

The paper *Contour Etching*, by MR. A. W. SHEPPARD of Saunders-Roe, Ltd., described a relatively new application of an ancient technique. The speaker said that his company turned to this method because of the trouble experienced with machined-in stiffness spoiling skin profiles; they had a pilot production shop operating. Mr. Sheppard offered four points in favour of the method: economy in machine tools; weight saving; elimination of retail tools; much simplified paperwork.

There are four stages in the process: (1) *Pre-treatment*, i.e., degreasing, pickling and washing. (2) *Masking*, application of a strippable coating, over which is placed a stencil, cut round with a knife; the "permanent" areas are then stripped off, after which a primer and the "resist" coating are sprayed on and, finally, after stoving, the strippable coating on the etching areas is stripped. (3) *Etching* is in a 12 per cent sodium hydroxide solution at 80 deg C to give 0.045 in/hour. (4) *Post-treatment* is a five-minute cold-water wash, five minutes in a 10-30 per cent nitric acid solution, a cold/hot rinse for ten minutes and, finally, removal of the "resist" by a ten-minute immersion in paint, followed by a last rinse. The stiffness of the "resist" coating is critical, as shown by the sketch (Fig. 3); given the correct value the radius at the edges will be equal to the depth. The etching rate is maintained constant by seeding with aluminium oxide.

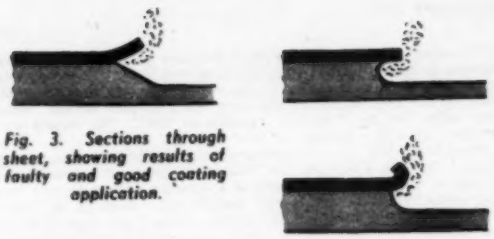


Fig. 3. Sections through sheet, showing results of faulty and good coating application.

Parts illustrated by the lecturer showed a wide variety of components of typical aircraft form which would normally be made by the attachment of stiffeners and doublers, or by machining. Taper thicknesses and curved skins could be produced. An interesting example was a chordwise joint in a curved skin—such as a leading edge—in which the edges had been recessed to make a flush lap-joint without a butt strap. A perforated grid in material 0.006 in. thick was made with a photo-sensitive coating, but was the thickest upon which a vertical edge was obtainable.

Points from the Discussion

Three points were made from the chair on the three papers. (1) Magnesium needed a much better sales service than it has: builders of naval aircraft should have been pushed harder with its non-corrosive properties—and the magnesium suppliers could start with Supermarine. All in all, it made one wonder if the U.S. were ahead with materials. (2) It would be interesting to know a lot more about welding titanium. (3) There must be a tremendous future in contour etching, with its saving on finishing—and why not tape control for the manufacture of masks?

MR. W. E. MILLS (Avro) considered that contour etching was in its very initial stages. He thought that stripping by knife was crude and might initiate cracks, so why not a chemical method? Five minutes seemed short for washing. Had any prolonged fatigue tests been made upon etched material? The description of finish was nebulous; could C.L.A. values be given? He thought that stress corrosion had been dismissed too easily. Mr. Sheppard replied that knife stripping was the most satisfactory and the girls quickly learned to cut the coating without marking the metal—the polyamide cured epoxy resin "resist" was both acid- and alkaline-proof. Etched parts had been left lying around for two and a half years without any sign whatsoever of "after-etching."

MR. W. S. HOLLIS (M.o.S.) said that the N.G.T.E. had prepared a manual of methods for welding turbine components which covered most of the points raised; this had apparently not reached aircraft firms but would be available to them. He also recalled the successful use of magnesium alloy for the tracks of gun turrets during the war, which work-hardened after the chromate wore off and wore well without corrosion. Mr. Wilkinson thanked the speaker for mentioning this and said that it was an excellent material where bearing pressures were low; he instanced de Havilland camshaft bearing inserts, which never failed and never needed replacement.

A rather vague question elicited a very informative dissertation from MR. WILKINSON. The new American AZ 31 has a good paper performance, losing little weight in an immersion test, but it is subject to deep pitting at an inclusion—which can be catastrophic. The new British equivalent loses more weight, but does so all over without any pitting, moreover, it has a higher residual stress after heating to 300 deg. C. The B-52 aircraft carries 4,500 lb of AZ 31B, while the outer skin of the thermally anticed leading edge of the Boeing 707 is also of AZ 31B. Boeing were investigating, and Chance-Vought had applied to the Crusader, chem-milled magnesium alloy. The significance of using magnesium is less the actual weight saved than the use of thicker, better-stabilized, stiffer material and the reduction of the number of components; hence the number of stress-raising fastenings was also reduced.

To a question from MR. K. E. CHEVERTON (Bristol Aircraft), Mr. Gardner said that spot-weld fatigue tests for the wing case were +6.5 to −7.5 per cent of design load, and the target of a million reversals was reached. The pressure cabin test was from zero to design load. Boeing had set a target of 65,000 reversals and found it easy to achieve 125,000. Handley-Page aircraft were designed so as not to buckle in the straight and level flight case. Loading had been stepped up until there was skin buckling, and even then the welds had taken twenty-five million reversals. Shrinkage cracks at the spot were a welding defect, but even a sandwich specimen with thirty of these did not fail—the breakages all came from rivet holes in the inner skin. Some 150 Victor and Hera'd parts had been tested without a single case of a failure originating from a weld. Corrosion between sheets gave no trouble, but a protective film could be used if welding was done while it was wet, as Sud-Est Aviation did with Araldite for the Caravelle.

MR. BROADBENT (Sterling Metals) considered that the U.K. was ahead of the U.S. on magnesium castings and said that his company supplied 8,000 a month to one customer—and that from 600 different patterns.

HELICOPTER AIRLINE

An Englishman's Impressions of New York Airways at Work

THERE are various ways in which to spend a spare day in pre-Christmas New York. I conscientiously decided that business came first, but I was to find that my call on New York Airways happily conjoined both business and pleasure.

I chose to call on this helicopter airline because over the past year or so I have formed a high regard for the way in which it and the Port of New York Authority have aggressively pursued the American principle of "We don't want to know your problems—we just want results."

New York Airways are worth watching closely, not only because they have produced results, but also because they are potential customers of Britain's helicopter industry. I quote the words of Mr. Robert L. Cummings, Jr., president of New York Airways, which he spoke at the dedication of New York's West 30th Street Heliport on September 26 last: "Just as Capital went abroad to buy the Viscount three years ago, present indications are that we may well be doing similarly in order to find appropriate equipment to render the best possible service to the public . . ." He referred later in his speech to New York Airways' interest in multi-turbined helicopters carrying 20 to 25 passengers, and added also: "In England today there is [a 40- to 50-seat helicopter] well advanced in construction which will fly some time next year. It is called the Fairey Rotodyne and gives very real promise of being able to perform the operations we need."

I talked with Mr. Cummings, and I shall record his views in amplification of the above remarks; but before doing so it will be as well briefly to acquaint the reader with the background to New York Airways. Reference to the map shows how the island of Manhattan is surrounded by the airports of La Guardia (domestic), Idlewild (international), Newark (domestic), and Teterborough (business and private).

On the west (Hudson River) side of the island is the newly opened West 30th Street heliport (see photograph overleaf). It is perfectly situated, because it is very roughly equidistant from each airport, and it is in the heart of New York's downtown business and commercial area. The airlines offices and headquarters are at La Guardia, where the fleet of five S-55s, three S-58s (three more to come) and one Bell are based.

The operations are threefold: (1) Suburban services from the central W. 30th St. heliport to the points shown on the map; (2) services from the heliport to the airports of La Guardia, Idlewild and Newark; and (3) the busiest service—shuttle flights between these airports every 45 min. Passengers, cargo and mail are carried by day, but, as yet, only cargo and mail at night.

Unlike the European helicopter operators Sabena and B.E.A., New York Airways is a private company (550 shareholders); but, like the helicopter divisions of those airlines, it receives a government subsidy. N.Y.A.'s greatest assets are the backing it gets from the Port of New York Authority—owner and administrator of all the New York airports—and, above all, the natural opportunities for helicopter operations presented by Metropolitan New York's bustling commerce and congested geography.

Robert Cummings' office is at La Guardia, whither I flew by

ON arrival in New York by B.O.A.C. DC-7C (see "Flight" for January 4), J. M. Ramsden of our editorial staff sampled the all-helicopter services of New York Airways before going on by American Airlines to the West Coast to visit Lockheed (pages 47-49 last week) and Douglas—as described in the immediate preceding article in this issue.

S-55 from Manhattan (more of this experience anon). "How did you like the ride?" he beamed—a question which I answered affirmatively and enthusiastically. It was, I felt, the sort of question that an airline president might have asked 25 years ago when fixed-wing operations were in the same state of infancy as helicopter operations are today.

He was, he said, "keeping up with equipment as closely as we know how," and by equipment he included the Decca Navigator. They had now introduced S-58s, "the first helicopter that really looks like a vehicle." The S-55 did the job, but passengers transferring to it from plush airliners were likely to be a bit disillusioned about the much-publicized wonders of helicopter travel when they found they had chickens as co-passengers. (The five-seat single cabin of the S-55 has a netted-off portion for freight. The S-58 has two extremely plush six-seat cabins.)

They were, explained Mr. Cummings, charging 54 cents a mile for the short services. This was less than the taxi-fare: but no-one was going to ride with you at 54 cents a mile over the longer distances when surface travel was cheaper. "We reckon that ten cents per seat-mile is the right direct operating cost," because over the longer distances you had to get down to "fixed-wing-plus-taxi" fare levels.

I asked whether he considered that the right helicopter to work best at this cost was not a big 40-seater like the Rotodyne. "Not necessarily yet," he said. "The market for the larger ship is in the longer hauls." He was looking next at something smaller—"a 20- to 25-passenger ship would make us happy." The Rotodyne was essentially a helicopter for London-to-Brussels or London-to-Paris types of service, both long hauls, and where there would be the traffic to fill 40 seats. It wasn't the number of seats that was going to bring down cost per seat-mile: it was the turbine engine. The simpler, more efficient and lighter engine would bring about a simpler hull, gearbox and rotor, and hence a much lower overall weight. Add to this more seats and you were really getting somewhere. "But," he said, "we'll not be happy until we've got multiple engines." They could then do without floats—those at present fitted to their S-55s and S-58s at the expense of passengers were nothing more than "a second engine."

He was disturbed about the "inadequacy of manufacturers' commercial plans" and the fact that the industry was dependent on military orders. "Bristol seem to shape up nearest to our plans," he said. (This was a reference to the forthcoming 25-passenger Bristol 192 powered by two Napier Gazelles.)

Quick quotes from among Mr. Cummings' other remarks: "The only way on short-hauls is frequency—to give service to the public and to generate traffic." . . . "We prefer to call our government subsidy a 'public service subsidy'—it sounds better

"Flight" photograph

The lights are on at La Guardia as the last passenger service of the day arrives from Manhattan—12 minutes away by S-55, an hour and a half by car.

The Port of New York Authority's heliport—two concrete pads jutting out over the Hudson River from West 30th St., near the heart of downtown Manhattan.

that way—but in the end the customer has got to make us pay." . . . "The patience and backing of the Port Authority has been well beyond their call of duty."

I would have liked to have gone on talking helicopter shop for hours with Mr. Cummings. I felt he wouldn't have minded, either; but his assistant came in to say that someone had arrived who had been waiting to see him for two weeks to talk about helicopters for civil defence. "You see," he said ruefully, "we have a try at anything to justify our subsidy." I had the impression that the main objective of this private enterprise helicopter operator was to get rid of his subsidy just as quickly as he could.

I referred earlier to the possible comparison that might be drawn between the state of the commercial helicopter today and fixed-wing transport in its infancy. I was made delightfully aware of this from the moment I arrived at the West 30th Street heliport to pick up the last service of the day from Manhattan to La Guardia. I suppose I had vaguely imagined New York's heliport to be in character with the splendours of Grand Central Station or of the East Side Air Terminal. I am certain I never imagined it as two slabs of concrete and one small building lapped by the Hudson River—which is all it is. But what more is needed at this stage of the game?

Warren Goodman of the Port Authority, who took me there in his car, was nevertheless as proud of it all as he was of the scale model of the future Idlewild International he had shown me in the morning. This heliport was, he explained, "only the beginnings": plans for its considerable enlargement were in hand, as they were also for the construction of other heliports elsewhere on Manhattan island.

I was indoors reading about what to do in the unlikely event of an unscheduled water landing when our S-55 was heard pounding overhead, causing a sudden flurry of activity among the seagulls and the three-man heliport staff. We watched it make a leaf-light landing on its slab, and heard the heliport manager call out to the pilot: "How much can you lift?" It transpired that we would be 75 lb over-weight unless the mechanic got out, which he obligingly did—mildly protesting that he had a doctor's appointment at La Guardia.

I strapped myself in and surveyed the interior. It was not plush but it was by no means scruffy, even though the forward part of the cabin was partitioned off by cargo-webbing. On the left wall was a telephone labelled *Passenger to Captain*, and on the right a box for first-aid and a canvas bag marked *Life Vests*. Had the chairs been of wicker basket-work, we could, I imagined, have been aboard a cross-Channel D.H.18 in the early twenties.

Although I was sitting on the rear seat in between two fellow-passengers I could see that my view of Manhattan out of the red-curtained windows was going to be excellent. Our Pratt and

Whitney R-1340 (which didn't stop during embarkation) revved up to a noisy pre-take-off crescendo, and—almost unexpectedly—we lifted smartly off the heliport and swung out over the Hudson River (top left in the picture above).

From the right-hand windows we beheld Manhattan in all its many-storeyed magnificence as we flew parallel to the west side of the island as far as 96th St. Here we turned sharp right on course for La Guardia across Central Park (which is not, I was vaguely surprised to find, as green as the maps make it out to be).

Within ten minutes of leaving the heliport we had descended upon the La Guardia apron—jam-packed, as always, with just about every make of transport aeroplane in America. Warren Goodman, following us by car, would no doubt still be threading his way patiently through the traffic congestion of West 42nd Street.

I was met at La Guardia by Richard Wheatland, N.Y.A.'s traffic manager, who drove me in his M.G. to the airline's offices and maintenance hangar. The machines inside—two S-58s, three S-55s and a smart little Bell—made a pretty sight together in their bright blue and white N.Y.A. paint schemes. I was especially impressed by the luxurious interior of the S-58—there is no doubt about the fact that, single-engined though it is, this machine is the first real helicopter airliner yet.

I talked with the chief pilot Howard Higgins, who probably has more helicopter hours in his log-book (over 4,000) than anyone in the world. Minimum *en route* altitude over Manhattan, he said, was about 1,500ft for the S-55, or 700ft without flotation gear. This height was fixed according to the S-55's glide ratio (2½:1) and the location of the nearest emergency landing site. The main one on Manhattan is Central Park, hence the reason why we stayed over water until we were level with the park. Minimum altitude over water was 500ft. Visibility minima, he said, varied by night and day according to route: the forward minimum visibility requirement would generally be about one mile, with ceiling visibility depending on whether they were in a control zone or *en route*. Temperature accountability was "very strict"—in the summer, Howard Higgins said, the thermometer sometimes went up to 116 deg F, which virtually meant that the S-55 with flotation gear could carry only one passenger. Wind limitations depended upon the judgment of the pilot, but if the wind was blowing at more than 65 m.p.h. then everything was grounded.

I have described my talk with Mr. Cummings, but I didn't mention that, in the course of it, he recalled a remark made to him a few years ago by someone in B.E.A. It is worth recording in conclusion, just to show how ironically history can sometimes reverse itself: "We've got a heliport in London," said this B.E.A. man to Mr. Cummings "—what's wrong with New York?"

J. M. R.

Above, one of N.Y.A.'s S-58s passes over Ellis Island en route from Idlewild to Newark. Below, dusk embarkation for La Guardia at the Manhattan heliport, West 30th Street. **"Flight" photograph**

Talking Medium-haul Shop at Lockheed and Douglas

Part 2: A DAY AT DOUGLAS **By J. M. RAMSDEN**

WEST COAST STOP-OVER

I LEFT Burbank convinced that the turboprop was the sensible choice of propulsion for the world's short-to-medium-haul operators. Nothing Douglas might tell me on the following day would, I was sure, persuade me to think otherwise. Of course, the odd medium jets would be sold to people who could afford to run them—but not in any worthwhile quantities. To use the terms of the current American pop-saying: I didn't want to know the medium-jet facts—my turboprop mind was made up.

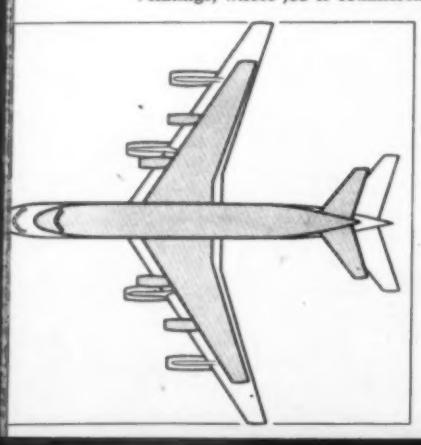
This was no mood in which to approach Douglas. And as it turned out, of course, they soon restored my depleted enthusiasm for the medium jet.

Having now heard the medium-haul beliefs of both Douglas and Lockheed I am prepared, like the Vicar of Bray, to profess or to apostatize either creed. Unlike the airline president, who is faced with the problem of investing cool millions in one or the other form of propulsion, I have nothing thereby to lose.

My host at Douglas was Al Chop, whose particular assignment is liaison with the foreign Press. He drove me from Los Feliz Boulevard, where I was staying, to Santa Monica—a 45-minute drive during which I was again awed by the size of Los Angeles. Like South-east Lancashire, it seems to comprise several Subtopian townships all merging into one another, with no intervening countryside. I was surprised—as I had been in New York—by the orderly behaviour of the traffic, which does not move with the Parisian disregard of life and limb that I had anticipated. I remarked on this later to Al Chop when the traffic politely halted outside the factory to allow us to walk across the main road. "You hit a pedestrian on a crossing," he observed, "and California's traffic laws will make you wish you were Bing Crosby—you'll need every nickel you've got." Later I saw that Al had a notice on his car's rear window which said: "Help Stamp On Sports Cars."

The white-façaded Douglas plant, which we approached by way of palm-fringed residential areas, is very much the traditional aircraft factory in appearance. The offices I saw were more businesslike than plush, and the whole place conveyed the sort of respectability that one would expect of Douglas. As at Lockheed, I went through strict but quick security formalities.

The first person to whom Al Chop introduced me was Ray Vennings, whose job is commercial sales. I put to him the conclusions of our market survey (December 14 issue), which were that the 1962 market did not appear large enough to make it worthwhile for all the eight firms competing, and, in particular, that the largest share of the short-to-medium range market seemed likely to go to the transports with the optimum economy over the shorter sectors, where in our estimate the bulk of the traffic lay. Ray Vennings warmed to this topic, but did not commit himself to any mention of the DC-9. He was interested in our write-off rate of piston equipment, and asked whether we had thought of the DC-7C as a short-medium transport—because, if we hadn't, Douglas and the airlines certainly had. It showed, he said, very good, Viscount-class economy over the short stages.



A prospective partnership which is strongly contesting the turboprop's challenge—the Douglas DC-8 and (shaded) the DC-9.

Al and Ray then took me to meet Lloyd Aschenbeck, supervisor of the market research at Douglas. Many times in the course of our traffic researches for *Flight* we have said to one another in so many words: "Oh to be able to see what Douglas have assumed." Their market research is well known for its thoroughness, though tantalizingly little is ever published. Here was my opportunity to see something of it at first hand.

Lloyd Aschenbeck has a department of 12 people devoted to providing the Douglas management with a detailed analysis of the future air transport market. I got the impression that, when the technical feasibility of a new project has been established, market research is the touchstone of any Douglas decision to go ahead. The twelve-strong team is on full-time market research, and is not part of, or even an offshoot of, one of the technical departments.

Lloyd Aschenbeck's office was crammed with awesome charts, one of which proclaimed the principles of market research. These were: (1) to collect aviation and economic statistics, (2) to analyze the transportation industry, (3) to forecast air traffic demand, and (4) to determine the amount of equipment needed by individual airlines and by the industry as a whole.

With seemly humbleness I briefly ran through *Flight's* medium-haul market assumptions and conclusions with the Douglas expert. He listened without comment; and when I had finished he produced, with a flourish, a black leather folder containing Cellophane-covered charts presenting the conclusions of his own medium-haul market researches. I suppose I fastened on to it over-delightedly, because he explained that it was not for publication; but I shall not be giving away any secrets if I note the ways in which it differed in scope from our own analysis. They were: (1) the unfilled market was assessed in terms of DC-9 seat-miles, and not in terms of the total capacities of every medium transport; (2) the year 1965 was examined and not 1962; and (3) the range of bands examined was wider—300 to 1,800 miles compared with the 500 to 1,500 miles of our analysis.

But Lloyd did give me a most enlightening paper he had written outlining his philosophy of market research and offering some conclusions about the U.S. domestic market; this we hope to examine in a later issue.

Five Cardinal Points

Whilst I was engrossed with Lloyd Aschenbeck and his tantalizing collection of charts, Schuyler Kleinhans—assistant chief engineer at Santa Monica—came beaming into the office. I first met him last June when he called on *Flight* in the midst of a European DC-8 and DC-9 sales tour (see the July 6 issue), and I had been looking forward very much to seeing him again and on his home ground. Nonetheless it was with some reluctance that I tore myself away from Lloyd Aschenbeck: I would have dearly liked to spend many hours talking to him and—had he let me!—probing his researches.

Schuyler Kleinhans talks in the way his jet airliners will fly—fast and with great appeal. When I entered his office I was still uncertain just how serious Douglas are about the medium jet. I emerged—to put it euphemistically—rather less uncertain.

I led off by asking whether Douglas were going ahead with the DC-9. In reply I received an inscrutable smile, and not until later in the interview was I to get a direct answer. He rose from his desk, picked up a piece of chalk, and walked across to the blackboard on his office wall. "The airlines," he began, "expect a new transport to be an improvement in five

respects on the airplane it is to displace. We have never yet marketed a new airplane that wasn't an improvement in each of these five respects." He chalked them up. First, capacity—up by 50 per cent. Second, operating cost. "This," he emphasized, "is fundamental, and it has to be reduced by 20 per cent." Third, performance. There had to be a 20 per cent improvement in range and in speed. The airlines wanted more than improved costs—"you've got to do something to improve their revenue." Fourth, comfort. This was something that couldn't be measured quantitively, but the interior had to look different, and you had to give people a smoother, quieter ride. Fifth, safety. This was difficult to measure, except against the background of the falling curve of accidents per million passenger-miles. "You have to fit better bad-weather aids, autopilot and flight control systems, navaids, brakes, reverse thrust, and so on."

Mr. Kleinhans repeated that in their long transport history Douglas had not yet marketed a new aeroplane that was not an improvement on the type it was replacing in each of these five respects. He referred of course to the DC-3, DC-4, DC-6, DC-7 and DC-8—each type separated by about six or seven years, and each (except, strictly speaking, the DC-8, which has still to be proved) better than its predecessor in the respects outlined by Mr. Kleinhans.

These five *desiderata* for a new transport were, I felt, incontestably well based; but I wondered how the DC-9 fitted them. That aeroplane, I knew, is to displace types like the DC-6 and Connie, and to a lesser extent Convairs: without a doubt it would be an improvement over those aircraft in all five respects—yes, even in operating cost. And the DC-9 would, I felt, be at least as great an improvement over them as its turboprop competitors in all respects except perhaps one—operating cost over the short, 200- to 500-mile distances.

Comparative Costs

I put this to Mr. Kleinhans. He had not referred by name to the DC-9, but he did so now. On the board he sketched out short/medium-range cost curves (on non-dimensional axes) for typical turboprops and "jets of the DC-9 class." For a short distance along the range axis the turboprop showed up best on cost: then, at a point where the jet curve began to fall more steeply, the turboprop curve began to rise sharply—until the two crossed at a point which could, from the rough proportions of scale, have been about 300 or 400 miles.

Although he did not say so in as many words, it appeared that Mr. Kleinhans was conceding a small superiority in operating cost to the turboprop—but only over the short distances. Beyond those distances the jet appeared to become markedly and progressively superior in cost. Pointing to the turboprop curve he said: "This is a specialized vehicle. But I'm not saying that turboprops are fools—I'm certain they're right for certain things." He referred to what he called the "*volte face* of some of the turboprop proponents"—how they had once emphasized that their form of propulsion was the more economic over the longest ranges, but had changed their tune now. "Someone's right," he said, "and someone's wrong."

The DC-9, he said, showed the five desired improvements, better in each respect than its turboprop competitors, though its job could be done better over the very short distances by what he termed the "specialized vehicle." I thought he was perhaps making the turboprop look *too* specialized, but I accepted his points that the DC-9 showed better costs at any rate over the longer distances, and that for good measure you got for your money the attractions of greater speed and superior comfort.

One of his other DC-9 points is worth amplifying, because it is one not often raised in the jet *versus* turboprop controversy—perhaps because it is not easy to express simply. This is that, if long field lengths are acceptable—say in areas like North America and Europe where good airports abound—the jet can be shown to give a very marked superiority in economy over even the very fast, 425 m.p.h. turboprops. This argument is illustrated in the Douglas curve on the right below. At first I thought this was just a backwards way of saying that the jet needs a longer runway. But I do not think this is so: basically the turboprop has roughly twice the take-off thrust of a turbojet of comparable compressor size. But the turboprop's ratio of cruise thrust to take-off thrust is comparatively low. And if you can show that, using a jet and turboprop of *equivalent* take-off thrust, that the jet will still reap the reward of better economy over the longer distances, how much more economical would the jet be using an engine with a lower take-off thrust? Cruise thrust, hence speed, would still be relatively high, but using a much lighter and more economical jet. These thoughts, I should explain, are as expressed by me and not by Mr. Kleinhans, who just put them into my mind.

The Douglas transport which takes the palm for low operating cost —the DC-6B.

Then, as I expected, he mentioned what I think is one of the most compelling arguments for the DC-9, and one which I know Douglas have been selling hard to the airlines—particularly to those who have bought DC-8s. This is the "paired jet transportation system concept"—and it is not, I think, just another of the many "systems concepts" which the Americans delight in devising. The proposal that an airline should employ a small jet to feed and act as partner to its big jets appears to be natural and logical, especially if the aeroplanes concerned come from the same shop and are to a great extent technically and operationally interchangeable. This is the kind of partnership that Douglas are propounding for the DC-8 and DC-9.

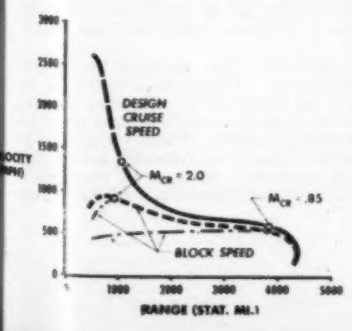
I asked Mr. Kleinhans whether he did not consider that the Rolls-Royce Avon RA.25 would be ideal for the DC-9. "We've looked at all the engines," he said, "—Rolls-Royce, G.E., Bristol, Pratt and Whitney, and they all make a fine airplane. But with different engines you get different airplanes—you just can't help it. The engine is the rock or the sand on which you build the thing." They just had to get to that "continuity of design" between the DC-8 and DC-9—airframes as well as engines—and the fact is that the Pratt and Whitney J52 is a scaled-down J57.

I began to see that there was more behind the DC-8/DC-9 relationship than vague talk about "technical interchangeability." Systems, components, equipment and accessories would all work the same way and in many instances be taken out of the same store.

I came back to my first question, putting it in a different way. "If you had a big order today for the DC-9, would you go ahead with it?"

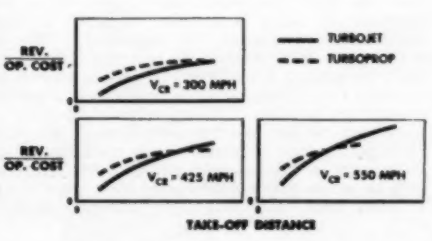
The reply was straightforward and immediate. "I don't think so," said Mr. Kleinhans—Douglas didn't quite work that way. The decision to go ahead would be a consideration of the management "who are pretty good at judging this kind of thing." Douglas weren't like Socrates, "who put his head in his hands and worked out that if a stone was heavier it fell faster." They looked at the thing "in the light of demand, philosophy—even whether the airlines *ought* to have it or not." (Coming from anywhere but Douglas that might have sounded pompous.) And they never moved in on a deal unless it was a technical decision first, business second. "We don't let ourselves be influenced by wants or hopes or wishes—just the facts. There's no magic about the way we do things."

Douglas appear to be in no hurry over the DC-9. My impression was that they are quietly mulling it over among themselves, but are nevertheless trying it out forcefully on the airlines—who are in no hurry either. As Mr. Kleinhans said, referring to both Douglas and the airlines: "You can only eat so fast, and you



Left, the Douglas view of the relationship between aircraft speed and range. The block speed of a Mach 2 supersonic transport is seen to be only 915 m.p.h. at its maximum range of 950 miles.

Right, illustration of the Douglas argument that, provided a longer take-off distance is acceptable, the medium jet shows a better ratio of revenue-to-operating cost than the turboprop.



WEST COAST STOP-OVER . . .

don't want to choke yourselves like a small boy who grabs too much candy."

How are Douglas thinking about the supersonic airliner? I had to find out, in view of what Mr. Hibbard had told me the previous day about Lockheed's confident feelings on this subject.

I was given a copy of a paper written a few months ago by C. F. Worley, chief of advanced design at Santa Monica. He went into the mathematics carefully (summarized in the illustration on p. 81), and concluded: "It appears that the short-range capabilities and the high operating costs of the supersonic transport, together with the small time-saving at the ranges for which the supersonic airplane is suitable, will limit the air-transport field to subsonic aircraft through the 1960s. By 1970, technical advances will probably justify beginning the design and development of supersonic transport types, but it is not likely that they will be performing any important part in the transport economy."

I had now heard Lockheed and Douglas giving their views on both medium-haul and supersonic transport. They couldn't have been more different. I was beginning to appreciate the dilemma of the airlines.

So far my time had been spent—as I had wanted it to be spent—talking, and I had yet to see the factory. Al Chop took me to see DC-6 and DC-7 final assembly, where aircraft are coming off the line at a rate of 12 to 15 per month. Regarding it all from a high vantage-point in the factory the irreverent impression made upon me by the array of DC-6A, 6B, 7 and 7C fuselages was of an aluminium sausage-machine. As in every aircraft factory at any particular point of time, nothing much appeared to be happening in the physical sense—just the familiar clatter of rivet guns and the wailing of windy-drills. But outside in the sunshine there was proof enough that the end-product was coming off the end of the line fast: the effect of the score of brand-new DC-6Bs, DC-7s and DC-7Cs spilled on to the Santa Monica tarmac from the factory was of a busy international airport.

The first sight of the DC-8 mock-up as one walks into what they call "the old B-19 hangar" cannot, I think, fail to be overwhelming. Painted white, and with the blue Douglas crest emblazoned big and bold upon its side, it awed me in much the same way as had the Empire State when I first gazed up at it from Fifth Avenue. My first impressions of the DC-8 were of the great size and extent of the double slotted flaps, the surprising smallness of the main bogies, and the large size of the windows. The interior—perhaps I was expecting too much—was not as big as I had expected, though by any present-day standards it is capacious. There was no particular theme to the cabin layout—for the reason I shall explain in a moment—and it was being used for trying out details and general effects. Odd points that I remarked upon were the recessed hat-racks, reading lights on the shoulders of each chair, and the absence of any "busy" styling—no fussy furnishings, and just pale colourings harmonizing to give a restful, airy effect.

Besides this single full-scale mock-up, which is used for engineering purposes as much as it is for furnishing experiments, are half-a-dozen separate wooden fuselage mock-ups—semi-cylinders built up from the floor—and inside which particular airline interiors are being tried out. "There's no such thing as a standard DC-8 interior," Al explained. "We have a separate mock-up for each airline." In this way, I thought, each customer could prevaricate to his heart's content in his own private mock-up—which could, I thought, be padlocked to prevent a rival from plagiarizing his ideas. The glimpses I had of the various interiors convinced me that point number four of Mr. Kleinhans' plan—"It's got to look different"—was certainly being implemented. Passengers in the nineteen-sixties, I felt, are not going to ride with an airline with old-fashioned ideas about interior design.

There were other mock-ups too—engineering rigs pounding the snags out of the DC-8's systems, and a detailed layout for the cockpit. This, I was surprised to find, was almost a replica in its overall design of the Comet's cockpit—certainly a complete departure from the DC-6 and DC-7.

There was the same comprehensive engineering panel on the right, with a chair (and, unlike the Comet, a table) for the engineer, and a spacious navigation station on the left.

There was a difference in scale, of course, and there was plenty of room for each pilot's seat to be accessible from around the side. Other details noted were: a large overhead window for each pilot; fuel cocks in the roof rather than on the central pedestal; trim levers instead of wheels; single weather radar-scope at the base of the central engine instrument panel. Visibility forward, sideways and upwards was the best I have seen yet in any airliner.

Left, DC-7C fuselage production at Santa Monica. Below, the full-size DC-8 mock-up in the old B-19 hangar.

By now my notebook was full and I had "factory feet." We returned to the office building (where I was pleased to meet two regular Douglas correspondents, Don Black and Hugh Gagos) Al telling me on the way what it was like to work for Douglas. His job of supplying information about the company to the outside world means—as I well appreciated—that he deals with a great many departments. "You wouldn't believe the co-operation I get from everyone," he said. "No one ever seems too busy or disinterested to help." It is, apparently, Mr. Douglas' influence which ensures that this is so; he has no time for "departmentalization" or for empire-builders. "If someone in the firm is not always helpful to everyone," Al said, "you suddenly find when you ring him up one morning he isn't there any more."

Certainly the help I had from everyone—at both Lockheed and Douglas—couldn't have been more complete. But individual warmheartedness was only one of the things that impressed me most strongly. I received two other impressions about America which, at the risk of being taken to task for proselytizing, I shall record.

When in New York I met an English friend, an aircraft engineer-salesman, who has been spending a considerable time in the States visiting airlines. What he said didn't apply to me, as I was not selling anything (except—one likes to think—*Flight*), but I feel his summary of the American outlook on business was fair and to the point. In so many words he said: "They are always very busy. But if you have a business proposal to make they will listen to you until all hours of the night, providing you have a very clear idea of what your business is. It's no use trying to sell a product vaguely—you've got to prove its utility with hard, plain statistical facts—otherwise you find that they're not listening."

My second impression was one with which, I think, most visitors to America return home. This is that, providing the business is there, nothing is too big to tackle. We were lounging in the car at Douglas discussing how the world's airports will fit the DC-8 and 707 (see *Flight*, May 4, 1956). I said I had heard in New York that the I.L.S. runway at Idlewild would need lengthening, and that this could only be done by extending it out into Jamaica Bay. The reply was succinct and typical: "Okay—so fill in the lousy bay."

The Rocket-boost Skeeter

Auxiliary Propulsive System Described and Illustrated

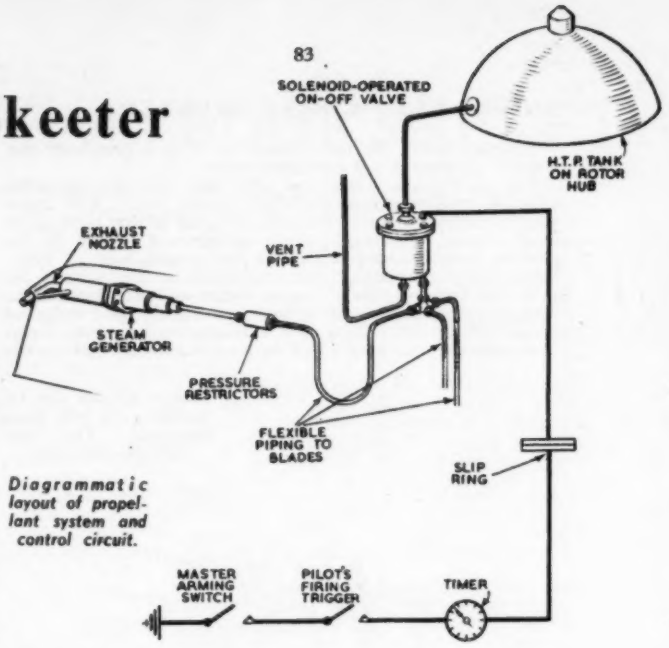
By C. FAULKNER, D.C.Ae.

VISITORS to last year's Farnborough Show will recall the startling performance of the Mk 5 Saunders-Roe Skeeter equipped with blade-tip rocket boost to supplement the take-off power of the Cirrus Bombardier (the production Mk 6 has the 200 h.p. Gipsy Major). In this brief article the system is described and its performance reviewed in relation to later marks of Skeeter. The author is chief project engineer of the makers' helicopter division.

THERE are strong arguments in favour of the use in helicopters of "mixed power" systems, so that the primary power unit, which gives adequate power in forward flight, can be supplemented by a booster system during take-off and landing, when substantially more power is required for short periods. In tropical conditions particularly, the power outputs of both piston-engines and gas-turbines drop sufficiently to penalize severely many helicopters operations, especially those involving flying from very restricted areas, such as jungle clearings. As a result, the need for auxiliary power boosting was very evident both in Korea and, more recently, in Malaya, where helicopters have been used extensively in military and rescue work.

The new booster system for the Skeeter has been developed in collaboration with the rocket-engine manufacturers, D. Napier and Son, Ltd. It gives the machine greatly enhanced vertical flight and climb performances, and permits operation with higher payloads in more severe climatic/altitude conditions than would normally be possible. In addition, in the event of failure of the main powerplant, the booster power is always available as a stand-by. Although insufficient by itself to maintain level flight, it can nevertheless greatly decrease the glide angle and so give the pilot more latitude in the selection of his emergency landing site.

The system is simple and can be fitted to the standard Skeeter with only minor modifications. Furthermore, although it was designed originally for the Mk 6 version, it is equally applicable to the later, more powerful, marks of Skeeter which are now going into production.



Diagrammatic layout of propellant system and control circuit.

The liquid monopropellant used in the Napier rocket motors is H.T.P. (hydrogen peroxide diluted with not more than 20 per cent by weight of water). This fuel is stored in a removable dome-shaped tank mounted above the rotor hub and is pumped to the rocket motors at the blade tips by the centrifugal action of the rotor.

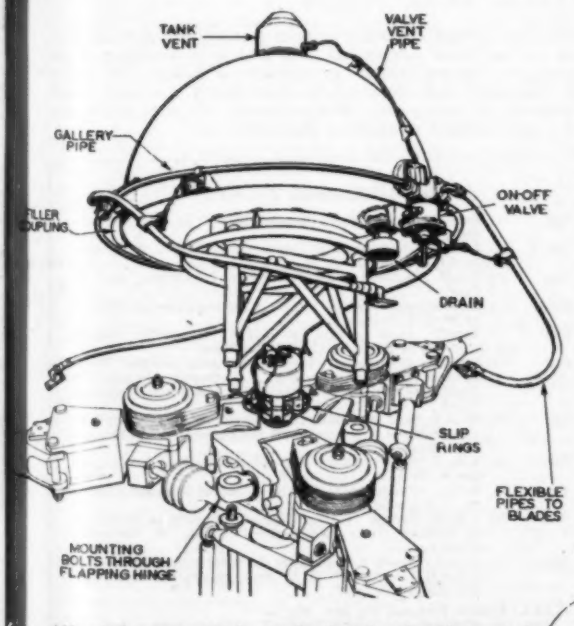
Feed pipes are housed inside the main spar tubes of the rotor blades, being supported at intervals by plastic spacers which locate the pipes centrally in the tubes. The rocket motors are attached to the ends of these spar tubes by bolts through flanged fittings on both the motors and the tubes. They are, therefore, easily removable for inspection or replacement; and the feed pipes and spacers can also be extracted from the blades without difficulty. On entering the motors, the H.T.P. is decomposed into superheated steam and oxygen. The generated gases then pass to a nozzle and are ejected at high velocity to provide thrust reaction.

As the booster power is supplied by thrust at the rotor tips, no additional torques are imposed on the existing transmission system and, hence, no modifications are required to either the transmission or the tail-rotor system. The boost is controlled by a solenoid-operated ON/OFF valve, actuated by the pilot *via* a firing trigger switch mounted on the cyclic-pitch stick, the switch being connected to the solenoid through slip rings at the rotor hub. In parallel, a vent pipe admits air to displace the hydrogen peroxide in the pipelines to the motors when the main supply is shut off. The control panel, situated on the cockpit dashboard sill, includes a car-type, key-operated master switch, a "firing ON" warning lamp, a timer giving fuel gone/available and a tell-tale safety meter which indicates the condition of the firing circuitry.

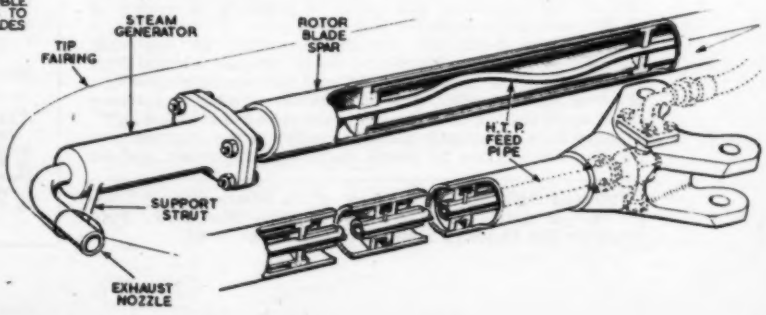
The present system allows for substantially constant thrust, although a degree of control is possible by varying the rotor speed, which, in turn, varies fuel pressure at the blade tip and hence booster thrust. However, a throttle control can easily be provided if required. This would consist of a valve operated by an electric actuator and, in this case, control would probably be achieved most effectively by adding a boost override in the normal twist-grip throttle on the collective-pitch lever.

The dry weight of the entire system is 36 lb and the dome tank can carry up to 86 lb of H.T.P. fuel. As the system is so designed that all major items are readily removed, the weight penalty involved when operating in regions where boosting is unnecessary is small, being of the order of 5 lb.

The present system is designed to give a thrust of up to 22 lb at each blade-tip unit, which is equivalent to a total of 67 h.p.



(Above) Arrangement of rotor-head tank, solenoid-operated valve, and slip-ring electrical connection to pilot's control.

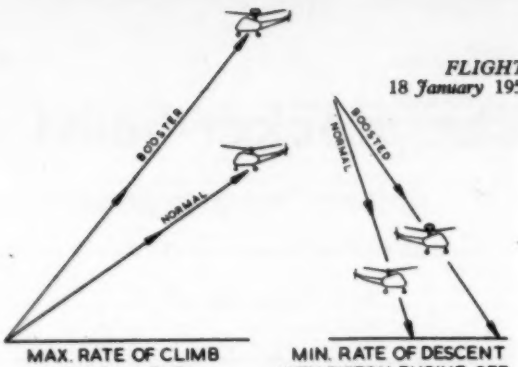


(Right) Method of conveying fuel to the blade-tip boosters.

THE ROCKET-BOOST SKEETER

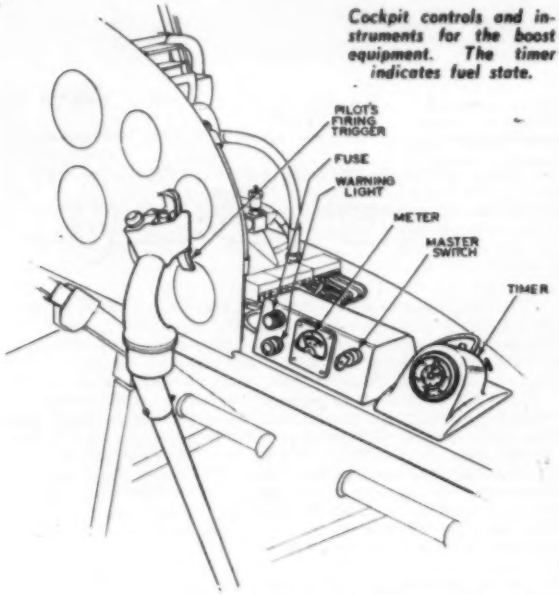
at the rotor hub. The tank capacity [illegible] minutes' duration at this maximum [illegible].

The accompanying chart and table [illegible] effect of rocket boost on performance of the Mk 6 [illegible] A.N. atmospheric conditions, the increase being typical [illegible] obtained in other climatic conditions. These performance figures are for identical payloads and piston-engine fuel weights and are, therefore, strictly comparable. But the system is flexible, and the values of both maximum booster thrust and duration can be varied considerably without greatly affecting the basic design of the aircraft or the system. For example, the maximum thrust of a given unit can be changed by introducing restrictors in the fuel lines; and duration depends entirely on the thrust required and on available tank capacity, which is restricted mainly by the acceptable limit of aircraft take-off weight.



SKEETER 6 PERFORMANCE COMPARISON (I.C.A.N.)

Condition	Normal	Boosted
Take-off weight (lb)	2,150	2,272
Vertical rate of climb, s.l. (ft/min)	230	1,470
Hover ceiling in free air (ft)	1,100	8,800
Max. rate of climb, s.l. (ft/min)	1,020	1,850
Min. rate of descent, piston engine off (ft/min)	1,350	650
Max. forward speed (kt)	88	100



Cockpit controls and instruments for the boost equipment. The timer indicates fuel state.

Various methods of fuelling the system are possible. The recommended technique is the use of a detachable aircraft fuel tank; when empty, it may be removed and replaced by a new, full one. Empty tanks can then be returned to base for recharging, or can be considered as expendable items. Alternatively, a technique similar to that used at Farnborough may be employed. The pipeline from a storage tank is connected to the aircraft tank through a self-sealing coupling and H.T.P. is then pumped until an automatic cut-off valve operates. Another method would be to pour fuel directly from suitably designed containers into a filler on top of the tank.

Sufficient work has been done, including a great deal of flight testing, to prove the complete practicability of the Skeeter rocket booster system, and performance test results have substantiated predicted figures. As a result, the operating potential of the Skeeter has been improved considerably and the complete success of the scheme represents a step of major significance in the development of British helicopters.

METEOROLOGICAL OFFICE ACTIVITIES

A DECISION is expected soon concerning the proposed combined headquarters for the Meteorological Office, to replace the existing establishments at Dunstable, Harrow and London. This news is given in the director's foreword to the Office's recently published annual report*, which appears this year—centenary year—in a revised and illustrated form.

In the section devoted to meteorological services for the R.A.F. the introduction is mentioned of a special teleprinter network by which Fighter Command stations exchange weather reports every 15 minutes. This need arose from the short endurance of modern fighter aircraft and the ensuing necessity to select alternative airfields at short notice. Developments in bomber types, the report continues, and in particular their increased ceiling, range and speed, are posing new meteorological problems. Plans were therefore made during the period reviewed for major changes in the procedure for the supply of meteorological information to Bomber Command units.

On the research side, the Meteorological Research Flight at Farnborough (using one Hastings, one Varsity and one Canberra) obtained "remarkable new evidence" on the occurrence of dry air within frontal regions, in addition to much basic data on condensation trials, clear-air turbulence, cloud structure, water content and particle sizes, condensation and freezing nuclei, humidity within the stratosphere, and ozone distribution. With the installation of accelerometers and other equipment, information on the occurrence and nature of gustiness to heights of 50,000ft was accumulated for R.A.E. analysis.

The Flight co-operated also in experiments on large-scale diffusion by collecting fluorescent tracer particles released from the ground. These experiments "should indicate the effectiveness of silver iodide smokes, generated on the ground, in reaching cloud layers above a critical point in the theory of rain-making."

Other lines of research included studies in the forecasting of pressure distributions by purely mathematical methods, and the problem of airflow disturbances over mountains. A theoretical study on this latter subject indicated that large lee-waves might depend on a "rather critical" combination of factors, and it was also discovered that radio-sonde observations provided useful information on such waves. Model experiments, also, might provide a useful means of studying this problem.

**Annual Report of the Director of the Meteorological Office for the year April 1, 1955, to March 31, 1956* (Illustrated). Published by Her Majesty's Stationery Office, price 3s 6d.

FORTHCOMING EVENTS

Jan. 23. Kronfeld Club: "Flying Reminiscences," by C. A. Nepean Bishop.
Jan. 24. R.Ae.S.: Main Lecture: "Aeronautical Research in Holland," by Prof. Dr. Ir. H. J. van der Maas.
Jan. 29. R.Ae.S.: Section Lecture: "Design for Production," by E. D. Keen.
Feb. 2. British Interplanetary Society: "Accelerations in Flight," by W/C. F. Latham.
Feb. 7. R.Ae.S.: Main Lecture, at Halton, "Synthetic Training Methods in Aviation," by W. Makinson.
Feb. 11. Institute of Transport: Brancker Memorial Lecture: "Competitive Economics of Pure-jet v. Turboprop Aircraft," by Marshal of the Royal Air Force Lord Douglas of Kirtleside, G.C.B., M.C., D.F.C., M.Inst.T.
Feb. 12. Joint R.Ae.S. and Helicopter Association Lecture: "Vibration Problems Associated with the Helicopter," by O. L. L. Fitzwilliams, A.F.R.Ae.S.
Feb. 14. R.Ae.S.: Main Lecture: "The Fairey Delta," by R. L. Lickley and P. Twiss.
Feb. 16. British Interplanetary Society: Chemical Demonstration by Dr. J. Diederichsen.
Feb. 26. R.Ae.S.: Section Lecture: "Recent Advances in the Design of Aircraft Tyres and Brakes," by H. W. Trevaskis, A.F.R.Ae.S.
Mar. 7. R.Ae.S.: Tenth Louis Bleriot Lecture: "New Methods in Aircraft Production," by M. Badré, production director of Sud-Ouest Aviation.

R.Ae.S. Branch Fixtures (to Jan. 30):—
Jan. 18, *Birmingham*, "Aerial Survey," by Mr. Dawe. Jan. 24, *Bristol*, "Application of Wind Tunnel Results to Aircraft Design," by M. Wilde. Jan. 30, *Preston*, "Diving and Underwater Engineering," by I. Fraser; *Southampton*, "Atomic Energy for Aircraft Propulsion," by J. E. Perkins; *Weybridge*, "Electronics and the Aircraft Industry," by Dr. C. F. Bareford.

THE AERONAUTICAL BOOKSHELF

"Panic Takes Time," by T. W. Willans. Max Parrish and Co., Ltd., 55 Queen Anne Street, London, W.1. Price 15s.

HOW many activities can a man squeeze into his life? Terence Willans seems to have been trying to answer this question since the day when, as a 16-year-old orphan, he emigrated to Australia. Now, in *Panic Takes Time*, he looks back on the events which have led him to his present position as Britain's most experienced test parachutist.

The teenage Willans grew up the hard way—in the Queensland outback, where he picked up such mixed skills as horse-breaking, shooting, ploughing, fencing, cotton-picking, fishing (with gelignite), tree-clearing and—as the junior member of a travelling rodeo—rough-riding.

The outbreak of war in 1939 brought him back to England with an ambition to become an R.A.F. pilot, but this was frustrated by a colour-vision test; so he joined the Army.

Willans graduated rapidly from horses to tanks and then to parachutes, and it was during his early days in the 4th Parachute Battalion that he acquired the now-famous nickname "Dumbo." It happened on an outdoor exercise. "I am not really designed for running," he recalls, "and one day on a particularly hectic gallop I found myself leading my platoon from something like a hundred yards to their rear. Our company commander was rather more athletic than was good for any of us, and having trotted lightly to the top of a hill, he stopped and looked back. . . . 'Come on, Dumbo,' he shouted, 'unfurl your ears and fly!' " This was a little unfair, the author adds, "because my ears are said to be very small. . . ."

Dumbo parachuted and fought in Italy, Southern France and Greece, remaining an Army parachutist after the war to develop new techniques and equipment. His last three jumps before leaving the Army (with the rank of major) were made in a little over three hours. By now he had developed a taste for manually operated parachutes and was performing regularly at air displays. Some of his most memorable jumps were from the Tiger Moth which he co-owned with the late "Doc" Morrell, with Neville Duke's Tomtit joining in the act.

In November 1949 Dumbo made the first live trial of a barometrically operated parachute, stepping out at 15,000ft to fall free for 52 sec before the automatic release functioned. Eight months later he tried out the Mk 2 barometric release, this time from 25,000ft. But despite his choice of occupation, Dumbo has always been liable to air-sickness; and on this occasion, having spent most of a 71-sec free fall in a spin, he succumbed.

So the book takes us, by the way of various other adventures, to Dumbo's latest—the first live test, just a year ago, of the Folland ejector seat. Already both the test and the equipment have proved their worth.

Between jumps the author has found time for a remarkable variety of pastimes, the objects of his apparently unlimited enthusiasm including guitars, tape-recorders, cameras, guns, cars and hydroplanes. And he is a very capable writer, as *Panic Takes Time* proves. Our only criticism of this immensely likeable autobiography is that there is not enough of it—particularly on the subject of parachuting. Some illustrations, too, would have been welcome.

R. J. B.

"How I Became An Air Stewardess," by Cynthia Arpthorp. Thomas Nelson and Sons, Ltd., Edinburgh 9. Illustrated. Price 6s.

MISS ARPTHORP traces her career from the post-World War II pioneering days in British South American Airways, when the cabin crews had to struggle with inadequate equipment in converted Lancaster bombers, to the comparative luxury of her present employment with British Overseas Airways.

When Miss Arpthorp is being truly herself her story is amusing, instructive and enthusiastic. She gives practical advice on how to follow her example, and rightly stresses that the work is hard and its compensations, though many, are well earned. She gives entertaining descriptions of some of the countries she has visited and of some of the extra-ordinary flights in which she has participated.

There are times, however, when the shadow of her company's public relations officer lies darkly on the page; there are some, too, when his blue pencil could have been applied with vigour. We would question, for instance, the advisability of giving almost four pages of a book on air transport—and those at the beginning—to the subject of air sickness. And the list of British airlines employing air stewardesses is neither accurate nor complete.

Finally, we have searched maps of the Middle East, which have been all too close at hand during recent weeks, and can find there no common Soviet-Iraqi border—yet.

P.S.

"Golden Wings," By Alison King. C. Arthur Pearson, Ltd., Tower House, Southampton Street, Strand, London, W.C.2 Illustrated. Price 15s.

WOMEN did many brave and admirable things in the last war, carrying out Civil Defence duties in the blitz, courageously parachuting into Occupied Europe, and flying all types of aircraft as members of the Air Transport Auxiliary. Yet even under the most hazardous conditions they seemed to have retained their femininity; and certainly in the air a Special Providence seems to have watched over them.

Miss King (who is now director of the Women's Junior Air Corps), in her story of some of the women pilots in the A.T.A. describes how one of them landed safely at Hamble in a Hudson through a rising balloon barrage, and how another took a Fairchild into Rochester, and a Stirling out, through balloons hidden by low cloud. Most remarkable of all, a young woman flying a Barracuda off the east coast of Scotland found herself in cloud down to sea level, ditched the aircraft, sank in it to the bottom, opened the hood and rose to the surface, started to swim for shore, was picked up by a fishing smack which appeared out of the mist, and within an hour was back on dry land.

But fortune, in such cases, quite justly favoured the brave and fair; for the women pilots of the A.T.A. did a plucky and invaluable job. Their determination, skill and abundant sense of humour (which got them over many difficulties) are admirably recounted by Miss King. With excellent descriptive powers and the ability to tell a good story, even against herself, she vividly records the spirit of those adventurous days.

H. W.

Aeronautical History in Pictures. Published for the Science Museum by H.M. Stationery Office. 2s net (postage 3d).

THIS 32-page booklet, lavishly illustrated with 65 photographs, provides a compact, attractive and easily studied history of flight, from the Montgolfier hot-air balloon in 1783 to guided missiles in 1956. It forms an admirable commentary on the exhibits in the National Aeronautical Collection at the Science Museum, South Kensington, London, S.W.7. Copies are obtainable from there or from sales offices of H.M. Stationery Office.

OTHER BOOKS RECEIVED

Indian Skyways Aviation Directory of Asia, 1956. Aeronautical Publications of India, Ltd., Gandhigram Road, Bombay 23.

Molecular Flow of Gases, by G. N. Patterson. Chapman and Hall, 37 Essex Street, London, W.C.2. Price 60s.

Piece of Cake, by Geoff Taylor. Peter Davies, Ltd., 38 Bedford Square, London, W.C.1. Price 15s.

Wing Leader, by "Johnnie" Johnson. Chatto and Windus, Ltd., 40-42 William IV Street, London, W.C.2. Price 15s.

A. V. Roe, by Edward Lanchbery. The Bodley Head, 28 Little Russell Street, London, W.C.1. Price 10s 6d.

Extinction Bomber, by S. B. Hough. The Bodley Head, 28 Little Russell Street, London, W.C.1. Price 11s 6d.

No Moon Tonight, by D. E. Charlwood. Angus and Robertson, 105 Great Russell Street, London, W.C.1. Price 12s 6d.

The Analysis of Structures, by N. J. Hoff. Chapman and Hall, 37 Essex Street, London, W.C.2. Price 76s.

The Devices of War, by Norman Kemp. T. Werner Laurie, Ltd., 1 Doughty Street, London, W.C.1. Price 18s.

Men, Rockets and Space, by Lloyd Mallan. Cassell and Co., Ltd., 37-38 St. Andrew's Hill, London, E.C.4. Price 18s.

Lubrication of Bearings, by F. T. Barwell. Butterworths Scientific Publications, 88 Kingsway, London, W.C.2. Price 50s.

Fly for your Life, by Larry Forrester. Frederick Muller, Ltd., Ludgate House, 110 Fleet Street, London, E.C.4. Price 18s.

Aviation Cartography, by Walter W. Ristow. Card Division, Library of Congress, Washington, D.C., U.S.A. Price 85 cents.

The Exploration of Mars, by Willy Ley, Chesley Bonestell and Wernher von Braun. Sidgwick and Jackson, Ltd., 1 Tavistock Chambers, Bloomsbury Way, London, W.C.1. Price 30s.

Jim Bartholomew of the R.A.F., by Duncan Taylor. Chatto and Windus, Ltd., 40-42 William IV Street, London, W.C.2. Price 8s 6d.

Journalist in de Lucht, by Hugo Hooftman. N. V. Uitgeverij "De Kern," Amsterdam, Holland.

Supersonic Aircraft, by Hugo Hooftman. Arti, Alkmaar, Holland.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns; the names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

A.T.C. Cadets' War Service

I WAS very pleased to read in your issue of December 21 that Veronica Wolkersz, in her book *The Sky And I*, makes reference to the fact that a select band of A.T.C. cadets carried out flying duties with A.T.A. during the war. However, it would appear from your review that the cadets flew only with women pilots.

In actual fact, about early 1941, representations were made on behalf of the cadets employed by A.T.A. on various ground duties for permission to fly as passenger when possible, purely to gain air experience. The Chief Operations Officer, Cdr. Wills (Philip Wills of gliding fame) gave a sympathetic hearing but pointed out the insurance problem. At this time, however, a number of aircraft (Whitley, Hudson, etc.) were being flown by a crew of pilot and second pilot, the latter's duties being mainly the operation of the hydraulics in the event of failure, as they could not be operated by the pilot alone.

It was decided that A.T.C. cadets could admirably fulfil these duties, and from then until the end of the war in 1945, these cadets, and their successors, flew many hundred hours on a variety of aircraft including all the four-engined bombers, and also flying-boats. The writer personally flew some 300 hours on over a score of types before joining the R.A.F.V.R. in October 1943.

One cadet met his death in a Hudson, piloted by a woman pupil, which stalled and crashed in a field at Taplow, Bucks, in late 1944.

The above may be of some slight interest to those who have probably never heard of this small service performed by the A.T.C. during the war.

R. D. BROWN
Maidenhead, Berks. (Late 155 Sqn., A.T.C.).

London Off-limits Compared

I WAS particularly interested to read the article "London Off-Limits" in your November 23 issue. In my opinion, this article does an excellent job of outlining the official Government philosophy responsible for the lack of general civil aviation in the U.K., although the article itself probably was not written with that point of view in mind.

First, let me correct one statement made in it. This says that Idlewild and La Guardia Airports at New York are limited to scheduled and transport aircraft in much the same manner as are London and Paris Airports. This is not correct. The Government of the United States expressly forbids such discriminations at any civil airport in which Federal funds have been invested. I can and do use either La Guardia or Idlewild in my own airplane, whenever I have the need to do so. The operators of those two airports—the Port of New York Authority—would like very much to have the situation exist as you have said it does. They try to achieve this by charging very high landing and parking fees to private aircraft. But that's as far as they can go; neither those airports nor any comparable airports anywhere in the United States—including Chicago Midway, the world's busiest—can forbid non-airline civil aircraft from using their fields whenever they choose.

Now to get back to my point about official government attitude toward civil aviation. I realize that there are a number of reasons why private and business flying in the British Isles is limited. Governmental attitude is just one—but it's an extremely important one. The attitude that is applied to London Airport, as described in your article, outlines the problem very well. British Government officials responsible for civil aviation have arbitrarily barred non-transport aircraft from that field. They have arbitrarily declared that such operations would be unsafe. If they were seriously concerned with the facts, and had a sympathetic desire to encourage and promote any civil aviation other than that of the scheduled airlines, they could quickly determine that their traffic congestion explanation is fallacious. The latest annual traffic count I have for London Airport is 124,434 total movements. At the risk of incurring British displeasure at what might seem to be Yankee boasting, I feel that in the interest of factual accuracy I should point out that the following United States airports handle a higher volume of traffic than London: Austin, Texas; Bedford, Mass.; Dayton, Ohio; Des Moines, Iowa; Newark, N.J.; Nashville, Tenn.; Lubbock, Texas; Richmond, Va.; Sacramento, Calif.; and Tallahassee, Fla. None of these I have named, as you can see, is among our busiest civil airports in the United States. So the fact appears to be that either London Airport is really not even remotely as hazardous as British Government officials would have you believe, or we in the U.S. are inviting disaster throughout the country at every hour of the day and night. Fortunately, I think our accidents clearly refute the latter.

So we once again must point to the Government attitude and philosophy. London Airport is closed to other than transport aircraft because British officials arbitrarily want to limit it in that manner. These officials, while presumably charged with responsibility for the development and promotion of civil aviation in your country, in reality have neither the knowledge nor the interest in any civil aviation other than that of the scheduled airlines. I am sure they regard what we call business and private flying as the sort of thing done by flying clubs far out in the provinces with ancient, rickety Tiger Moths.

The actions and reactions of British civil aviation officials clearly reflect this attitude. This results in complex and oppressive regulations being applied to pilots, aircraft, airports, traffic control, communications and so on. All of these added together make it highly impractical, if not impossible, to own and operate a private civil aircraft in the British Isles.

The policies that are applied at London airport, then, are the personification of this philosophy. I am as certain as I have ever been about anything that private and business flying in the British Isles never will achieve any significance, so long as this government attitude prevails.

Let me hasten to point out that I am fully aware of some of the other limitations that keep down private and business flying in the British Isles. I have discussed them a number of times at I.C.A.O. meetings with representatives of your government. I know that the small size of your country is often cited as an important reason why there is no practical service to be rendered by a private or business aircraft. I disagree with this, because in my opinion at least it is this very type of aircraft that makes the whole of the European continent easily and conveniently available to the average British citizen flying a private aircraft. I know too that you have a lot of beastly weather in the British Isles. But so do we; some of the most heavily populated areas of the United States also are subjected to some of the worst flying weather of any in the country—and, as you know, the vast majority (between 80 and 90 per cent) of all flying in the United States is done V.F.R.

I realize, too, that economics play a vitally important rôle in all this. Suffice to say that we too are faced with the loss of economics and we too had a very small aviation industry when the civil aircraft and facilities that served them were so limited that their use was economically unsound. Today many thousands of people throughout the United States (A.O.P.A. alone has 62,000 members, about 75 per cent of whom own aircraft) fly privately on a sound, economical basis.

That this is even possible in the United States is due in great part to the fact that the attitude and philosophy of the United States Government has been directed toward encouraging the growth of this industry. Because of that attitude on the part of our Government, we have excellent airway facilities, airport facilities, and an enlightened regulatory attitude. And because of this, aircraft manufacturers in the United States are able to produce useful aircraft that are economically sound.

When the British Ministry of Transport and Civil Aviation takes the steps it should to correct the problem outlined in your article, then I believe you will see the beginning of the growth of private and business flying in the British Isles. But that type of civil aviation will barely survive so long as the attitude of the M. of T. and C.A. remains what it is today.

Washington 14, D.C. MAX KARANT,
Vice-President, Aircraft Owners and Pilots Association.

[It is not exactly true to say that non-transport aircraft are "barred" from London Airport; but, as the article pointed out, entry is so hedged about with restrictions as to be virtually impossible.—Ed.]

Non-performing Flea

FOLLOWING the trend of previous letters towards "digging up" aircraft which are more or less just rotting away in some unobtrusive corner, I would like to report a find I have made in Doncaster.

The aircraft in question is, according to a mechanic I questioned, a "Flying Flea." This I cannot confirm as there seems to me to be several aircraft of differing design with this appendage. This particular one is a shoulder-wing (as on Comper Swift) and, as far as I can say, has a twin-cylinder vee-type engine. The aircraft is hung inside the roof of the garage, with the fuselage separated from the wings and tail surfaces. Its registration is G-AEKR.

I wonder if anyone can remember the flights of this diminutive aeroplane. I cannot, being a mere "lad" of 18 years.

Barnsley, Yorks. G. GRAHAM.

[G-AEKR was a "Flying Flea," or—to give it its more correct title—*Pou-du-Ciel*. Many were built by amateurs, to the designs of M. Henri Mignet.—Ed.]

THE INDUSTRY

Retirement of Blackburn Director

AFTER 30 years' service in a variety of responsible posts, Mr. W. A. Hargreaves, M.B.E., A.M.I.C.E., F.R.Ae.S., has been compelled through ill health to retire from the Board of Blackburn and General Aircraft, Ltd. He joined the organization in July 1927 as assistant designer, and subsequently became chief draughtsman and then assistant works manager. Later he moved up to the company's factory at Dumbarton and during the war was responsible for the production there of 250 Short Sunderlands. In 1951 he returned to Brough as works director. His retirement from the Board of Blackburn (Dumbarton), Ltd., for health reasons, was announced early in 1955, and towards the end of that year he retired from full-time duties but remained on the Board of the parent company.

New Canadian Hunting Company

A NEW member-company of the Canadian Hunting group, Hunting Technical and Exploration Services, Ltd., of Toronto, has been formed in order to specialize in natural-resources survey work. The new company has taken over—and will extend—the existing engineering services of the resources survey division of the Photographic Survey Corporation, which is responsible for the integrated resources inventories now in progress in Pakistan and Ceylon (under the Colombo plan) and for the 405,000 sq mile mineral survey of the Pre-Cambrian Shield in Canada and the U.S.A. known as Operation Overthrust.

Hunting Technical Service companies are also being formed in England and the U.S.A., and it is planned to form similar associated companies in other countries. The organization will offer consulting and advisory services concerning the development and utilization of natural resources, in addition to carrying out actual surveys.

President of the new Canadian company is Mr. Douglas N. Kendall, and Mr. W. H. Godfrey is general manager. Other directors are Mr. John Henderson, projects administrator; Mr. H. S. Scott, technical director; Dr. D. A. Macdonald; and Mr. J. B. McClusky, special projects engineer. Under Mr. Henderson and his assistant, Mr. George Higgins, are the following divisional chiefs: Mr. D. S. Lueder, general engineering; Mr. V. Merritt, forestry; Dr. Norman Paterson, geophysics; Mr. Robert Parkinson, geology; Mr. Richard Hodges, agriculture and land use; and Mr. John Jenkins, planning and economic studies.

"Tim" Morice Retires

THE retirement of G/C. C. S. Morice, D.S.O., M.C., from the post of aviation sales manager of the Dunlop Rubber Co., Ltd., took effect on December 31. G/C. Morice, who is 66, is one of the few men to have flown operational aircraft in both world wars. Educated at Malvern College, "Tim" Morice joined the Special Reserve of the Worcestershire Regiment in 1911 and was commissioned the following year. In August 1914 he went to France with the Third Division of the British Expeditionary Force, and during the subsequent twelve months was twice wounded.

G/C Morice.

While in hospital in February 1916 he joined the Royal Flying Corps. In 1917 his operational flying included an encounter with the Richthofen Circus, and a dog-fight with von Richthofen's own aircraft, after which Capt. Morice made an emergency landing in the British lines. He was awarded the Military Cross before the end of the war, and later was transferred to the Royal Air Force on its formation. He retired with the rank of squadron leader in 1926.

In 1927 he joined the technical staff of Dunlop and had become transport service supervisor on the tyre side at Dunlop's Albany Street depot when he was recalled to the R.A.F. in 1939.

His service in the second world war included periods as a censor to the Advanced Air Striking Force, an operational controller at R.A.F. Station Wittering, and commanding officer of an operational fighter station, before being given operational command of No. 121 Typhoon Wing of the Tactical Air Force. He was mentioned in despatches three times and received the D.S.O. and the Dutch insignia of Commander of the Order of Orange Nassau.

In April 1945 G/C. Morice retired from the R.A.F. at the request of the Dunlop Rubber Company to join their aviation division as sales manager, first at Foleshill, Coventry, and later in London. He has now moved to Tangmere, near Chichester, where he will pass his retirement.

Well known as a member of the Royal Aero Club, which he joined in 1945, G/C. Morice is chairman of the club's house committee and a member of the finance committee. He was one of the stewards of the 1956 National Air Race meeting at Coventry.

A Westland Appointment

IT is announced that Mr. Ralph R. Warren has been appointed personnel manager of Westland Aircraft, Ltd., and of its subsidiary company, Normalair, Ltd. He joined Westlands in 1936 from Boulton and Paul, and has held a number of senior appointments in the technical, engineering and production departments. As an assistant designer, he was closely associated with the development of the Whirlwind fighter, and later took charge of the Westland "shadow" factory at Doncaster, where production of the Lysander was concentrated. On his return to Yeovil he became assistant chief production designer, and until recently was technical planning officer and chief draughtsman.

Mr. Ralph R. Warren.

New Lubrication Products

AFTER extended research and service tests, the Molytone family of greases—Molytone Grease, Molytone L.M., Molytone X and Molytone C—is now being launched by Rocol, Ltd., Ibex House, Minories, London, E.C.3, in the U.K. and in Europe, the Commonwealth and Latin America.

Based on special Benton greases containing molybdenum disulphide, this new lubricant family has a wide field of industrial application. Benton greases, it is stated, introduce a new principle. Instead of a metallic soap, a modified Bentonite clay is used as the thickening agent. The resultant grease is said to be more stable in heat and to have a better adhesion to metals, better water repellence and less oil separation than other greases. Having no melting point, state Rocol, it can be used up to the point of inflammability of the basic oil. The combination of molybdenum disulphide with these new greases results in products—i.e., the Molytone family—which have the lubricating and pressure resisting qualities of molybdenum disulphide, together with the extra qualities of the Benton group.

Scientific Metal-sorting

THE Solartron metal sorter and resistivity test-set, Type MM 611, a product of the Solartron Electronic Group, Ltd., Thames Ditton, Surrey, is a lightweight, battery-operated instrument for use in sorting and identifying non-ferrous metals and alloys, measuring electrical resistivity, detecting surface flaws, and similar applications. It enables surveys and examinations to be carried out under conditions where no electricity supply is available or in confined spaces inaccessible to normal-size equipment.

Identification is based upon the specific resistivity of the particular metal—a physical constant of which every metal and alloy has its characteristic value.

When the test head of the instrument is brought near the metal its inductance changes and the oscillator in the instrument case ceases to oscillate. A calibrated dial is rotated until the oscillator comes into action again. This is indicated by a meter, and the immediate reading of the calibrated dial is the specific resistivity of the metal in micro-ohms per cubic centimetre.

Marconi Image Amplifier

TESTS of the Marconi X-ray image amplifier have shown that the industrial application of this fluoroscopic device can be as useful as its medical ones have proved. In both fields, it is claimed, greater detail can be seen with less radiation, thus saving time and money.

As an example of its industrial use the manufacturers, Marconi Instruments, Ltd., St. Albans, Herts, say that the production

Mr. R. V. Browne, to manage A. V. Roe's new research establishment in Australia. He has been asst. supt., new assembly, at Woodford for four years.

Mr. A. I. Fenwick succeeds Lt-Col. L. F. R. Fell as public relations manager to Rolls-Royce aero engine division. Col. Fell goes to the oil engine division.

Mr. Sidney E. Veale, appointed Press officer to D. Napier and Son, Ltd. Since 1943 he has been with the S.B.A.C., Sperry and Folland successively.

Among recipients of New Year Honours, as listed on p. 50 last week, was Mr. F. W. Gosney (B.E.M.), a skilled fitter at Blackburn and General Aircraft.

THE INDUSTRY . . .

of a certain type of investment casting entails the rejection of some 50 per cent after radiographs have been taken; but if the castings are first examined under an image amplifier, over 30 per cent can be rejected without the need for radiography, the remaining ones being radiographed in the normal way.

The same principle applies, in varying degrees, to many industrial components subjected to radiographic inspection; and the system overcomes objections to fluoroscopy as a subjective method of testing since no component is passed into service which has not first been radiographed.

Image amplifier operation involves the substitution of an electronic image converter tube for the normal fluoroscopic screen. This tube has its own fluorescent surface, upon which the X-rays passing through the object will impinge. The fluorescence excites a photo-electric plate and the electrons emitted are accelerated by a high potential applied to the tube by an external power source. A system of electron lenses focuses the image on another screen 1in in diameter, where the combined effects of acceleration and concentration give a considerable increase in brilliance. The optical system then magnifies this image to its natural size for viewing in a mirror.

Synthetic Rubber Plant

A WIDE range of new synthetic rubbers is to be produced by a recently completed plant at Fort Dunlop, Birmingham, which will make possible for the first time in the United Kingdom the experimental production of synthetic rubber on an appreciable scale.

Intended output is 1,500 tons a year, mainly of general-purpose rubber for tyres; and the plant (which has a high degree of automation) will be the first of its kind in the country to produce this material. It is also to carry out large-scale manufacturing and service trials of synthetic rubbers for treads, casings and other parts of a tyre; while a range of new rubbers will be put into service as research makes them available.

IN BRIEF

Mr. G. C. Tuvey, B.Sc.(Econ.), has been appointed sales manager of Zwicky, Ltd., Slough, Bucks.

* * *

Whitehouse Industries, Ltd., have opened new offices for their Philidas division at 44 Hertford Street, London, W.1 (Gro. 1402-3).

* * *

Rubert and Co., Ltd., Chapel Street, Levenshulme, Manchester, 19, have become sole U.K. agents for the Perth-o-meter surface roughness measuring instrument made by the Mannheim firm of Hommelwerke. They have already supplied their first example to Rolls-Royce, Ltd., Derby.

* * *

Mr. N. F. Rose has been appointed vice-chairman of Merry and Minton, Ltd., Northfields, Birmingham, and Mr. R. J. Ledwith and Mr. E. C. Mulford have been co-opted to the Board. Merry and Minton are an associate of Cellon, Ltd., and Mr. Rose is a director of both companies. Mr. Ledwith is chief chemist at Cellon, Ltd., and Mr. Mulford is works manager for Merry and Minton. Following the new appointments a programme for the manufacture of synthetic resins is to be announced.

This float repair kit, developed by the de Havilland Aircraft of Canada, Ltd., Toronto, Ont., is designed to provide the bush-aircraft operator with a method of making quick repairs. It can be used on damaged sections of up to about half a square foot, the aluminium mesh being used as a basis for the resin sealant. Each kit provides materials for approximately five medium-size repairs. Certain non-structural components, including tanks, may also be patched with the aid of the kit.

We regret to learn that Mr. T. Y. Dobson, O.B.E., V.R.D., a senior director of Davis and Timmins, Ltd., died on December 19 at the age of 73. Mr. Dobson had been on the Board of the company since its amalgamation with D Gilson and Sons, Ltd., in 1928 and was joint managing director from 1946 until his retirement in 1952.

* * *

Elliot Equipment, Ltd., of Llwynypia, South Wales, announce that Mr. F. E. Biles, joint managing director, has had to relinquish his executive duties for health reasons, though he will continue as an ordinary director. It is also stated that Mr. D. K. Hailstone has joined the company as director of sales; and that, for the greater convenience of customers, all sales activities, together with the development department under Mr. S. S. Wyllie, will henceforth be centred at 5 Falmouth Road, Slough, Bucks.

* * *

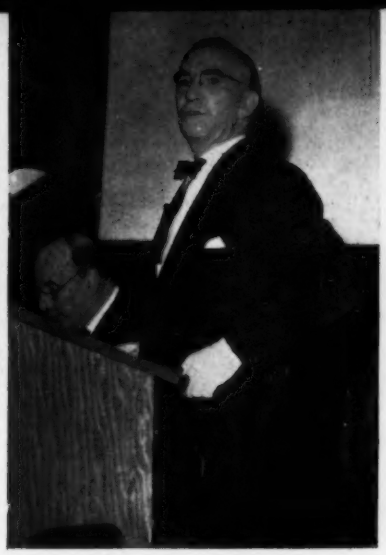
Latest information published by Howard Clayton-Wright, Ltd., Wellesbourne, Warwicks, on "Clatonrite" Self-Sealing Weatherstrip describes in detail the large number of sizes and sections available. For aircraft applications, utilizing natural rubber, a special compound is supplied which is lighter than the commercial material by approximately 7 per cent. One of the illustrations in a new brochure shows the use of the strip on Westland-Sikorsky helicopters.

* * *

Changes in the directorate of Export Packing Service, Ltd., have been announced. Mr. R. C. Boucher, formerly chairman and managing director, has relinquished the latter position and is succeeded in it by Mr. E. V. Norcock. Mr. Boucher remains chairman and the company emphasize that the change in no way affects policy. Mr. Boucher also continues as chairman and managing director of E.P.S. (Research and Development), Ltd., of which Mr. Norcock is a director.

* * *

Mr. Raymond Dorrington Bangay, foreign manager of Marconi's Wireless Telegraph Co., Ltd., since 1935, retired recently after being with the company for over 54 years. In 1921 he was appointed chief of designs, during the critical period of the evolution of radio practice from spark to valve technique; and in 1952 he became the first man to celebrate 50 years' service in the radio industry. Mr. Bangay will continue to serve the company on special projects and in duties connected with overseas business.



Aeronautics and the Engineer

Royal Aeronautical Society Presidential Address by Mr. E. T. Jones

ILLUSTRATED WITH "FLIGHT" PHOTOGRAPHS

Air Marshal Sir Owen Jones (left) proposed the vote of thanks to the President, Mr. E. T. Jones (upper right), for his address. Above, the scene during the reception.

THE Assembly Hall of Church House, Westminster, was crowded on the evening of Thursday, January 10, when the Presidential Address of the Royal Aeronautical Society was delivered by Mr. E. T. Jones, C.B., O.B.E., M.Eng., F.R.Ae.S. Introducing Mr. Jones, Lord Brabazon of Tara, a past president of the Society, said that this was the fourth such address in the Society's history; only two had been given during the first 89 years, and the custom had been revived by Mr. N. E. Rowe, on the Society's 90th anniversary in 1956.

Following the presidential address, extracts from which are reported below, a vote of thanks to Mr. Jones was proposed by Air Marshal Sir Owen Jones, a member of the R.Ae.S. Council, and seconded by Mr. P. A. Hearne, chairman of the Graduates' and Students' Section. A reception for members and guests by the President and Mrs. Jones followed, and a programme of films was shown. This included the London preview of *Song of the Clouds*, an excellent new Shell film on civil aviation.

The president's aim in his address, he told his audience, was to make them think of "three related subjects: the aeronautical engineer, the world's oldest aeronautical society (our own Society), and the world's newest form of transport."

In 1903 [Mr. Jones continued] the Wright brothers introduced to the world not only a vehicle that could fly but a new branch of science and a new engineering profession. The first vehicle of powered flight was an end-product in itself and it was quickly realized that each and every part of it would need concentrated development if the vehicle was ever to carry a useful load safely and at a speed which would be attractive.

Most of us would probably claim that the aircraft, like the steam ship, the locomotive and the motor car, developed very quickly over the first 40 years of its existence. But I wonder if the historian will think so. What are the facts? It took 42 years, including the stimulus of two world wars, to reach a steady speed of Mach 0.9 (Spitfire at R.A.E. in 1943) yet 13 years later, this speed had been doubled (Fairey E.R.103, 1956). In range, in load-carrying capacity and in altitude too, we find, taking the world by and large, as is proper in aeronautics, the same relative order of advance. . . .

In times like today, when the installed power of the country is being boosted and science and technology are forging ahead, a process considered expensive could soon become cheap; a production tool now thought too extravagant in power consumption could later become economic; and a complex commodity now thought difficult to maintain may become, like the watch, yet another symbol of simplicity and reliability. In such times we must learn not to call a new technique or new commodity complicated merely because we do not understand how it works, but to think instead of the many things we accept through usage without ever comprehending their techniques. In particular we must pass on the doctrine science and technology teaches that complexity is but a relative term; that those things which look right today may not be right for tomorrow and that the future revenue-earning capacity of a country cannot wholly be determined from the statistician's analyses of current economics. . . .

It is well known that the rapid development of the turbojet engine after the war led to large increases of speed and operational altitudes, but it is not well known that no ground facilities existed anywhere in Britain by which an engine could be tested in conditions simulating those at the altitude at which it would have to operate. Further, there was no wind tunnel in any Government Establishment or in industry in which a fair-sized model could be tested at either transonic or supersonic speeds. This unhappy state of affairs improved but very slowly, mainly because the steel required for new construction was for years after the war in short supply. A marked improvement came in 1955 and, before the end of this year, when the finishing touches have been added, we shall be better equipped than at any time in our aeronautical history.

In parallel with the construction of new Government wind-tunnels at the Royal Aircraft Establishment (Farnborough and Bedford) and of engine test facilities at the National Gas Turbine Establishment at Pyestock, each engine firm has installed, at considerable expense, equipment to provide a large mass-flow of high-pressure air for research and development testing of turbojets and ramjets; and each aircraft firm has constructed or is presently constructing, modern wind-tunnels and structural test frames. Many modern wind-tunnels have recently been erected. In all, well over 60 wind-tunnels of various sizes and speed-

Mr. and Mrs. J. Drinkwater being received by the President and Mrs. Jones in the Hoare Memorial Hall, Church House.

AERONAUTICS AND THE ENGINEER . . .

Left, Mr. J. Wright and Sir George Dowty at the reception.

Right, Mr. C. F. Uwins, Mrs. Uwins and Mr. R. E. Leete.

ranges have been erected in Britain since the war, and we shall soon have running more transonic and supersonic tunnels than we had subsonic tunnels before the war. This augurs well for the future since, for each new design of supersonic aircraft, at least ten different models are needed for some test or another in three different kinds of wind-tunnel—subsonic, transonic and supersonic.

It can now be said with some truth that our aeronautical establishments and the aeronautical industry have never before been so well equipped to tackle the aerodynamic, structural and propulsion problems of today and to develop the aircraft the users want . . .

The military fighter aircraft has already penetrated well into the supersonic speed *régime* and this experience has shown that the classical ground facilities for aerodynamic, structural and propulsion research, which for years have been the aeronautical engineers' stock-in-trade, will need augmenting in many different directions as the flight speed increases further. Kinetic heating problems, for example, will give rise to much research in heat transfer, control of the boundary layer and in the evolution of wing and cabin structures which can readily be cooled. There are, too, those more direct effects of speed, such as the time available to the crew to execute an action, and these will demand automatic integration of radar, electronic and instrument facilities and information to relieve the pilot and free him to do what man alone can do—think and command.

Moreover, the fighter aircraft is not the only vehicle of flight which now has a supersonic speed capability. There is the ground-to-air guided weapon, the air-to-air guided weapon and the unmanned aircraft. There is also the ballistic rocket, which first appeared as the V.2, and, though this vehicle does not fly in the usually accepted sense, it differs from the older forms of projectile in that it carries its own propulsion system and uses a guidance system. All these air vehicles therefore come within the charter for which our Society was established and the sciences, techniques and engineering practices employed are "Spheres of knowledge which distinguishes the 'Profession of Aeronautics.'" The "General Advancement of Aeronautical Art, Science and Engineering" which the Society is charged to foster is thus an ever-growing responsibility which we must prepare to undertake by widening the scope of membership and, as mentioned by our past President, Mr. Rowe, in his address last year, by the formation of Sections to give proper impetus to the new branches of aeronautics.

For example, your Council is currently working out the special coverage which the Society should provide in scientific, technical and operational fields unique to these uninhabited air vehicles. It is clear that some of the techniques and engineering practices employed in the development of unmanned vehicles of flight are not required in the manned vehicle. But to share the job that man and his aircraft have hitherto done so well will call for knowledge and skills in these uninhabited vehicles which have not been acquired in other pursuits. Equipment with a high order of sensitivity to many different forms of signals, coupled with a reliability seldom surpassed in any works of man, will be needed to match the very high speeds of some of these vehicles.

These new vehicles of the air, essential as they may be considered from the military point of view, are competing for a large part of the limited aeronautical effort and facilities available and, while in the main they are expendable, they may prove useful stepping-stones to other forms of air vehicle and in any event they will certainly help in the future development of high-speed manned flight. In other words, just as the existence of the aircraft urged the development of nuclear weapons so will these unmanned air vehicles provide data to accelerate further development of the aircraft . . .

In our quest for speed the hazard of poor visibility has taken second place and landing speeds have consequently increased in sympathy with cruising speeds. As we have already seen, long range, high speed and high loading taken collectively are conducive in civil operations to high revenue; thus the operator finds it more attractive to demand high cruising-speed than to demand low landing-speed. But a halt to this practice must be called and once again it would appear that the onus for giving this command is on the aeronautical engineer, that is on the engine designer, the airframe designer, the electronics designer, the instrument designer, and so on, by demonstrating that landing speed and cruising speed need no longer remain dependent design parameters . . .

A word about security would not perhaps be out of place. Actually this subject cannot be out of place, for is it not true to say that it is the combined efforts of the aeronautical engineer and the physicist, supported by scientists in all fields of science, that have placed aeronautics right in the forefront, not only of offence in war, but also of defence? In consequence we members of the Royal Aeronautical Society cannot be free to write as we will about our achievements. But I have heard some of our members say that security regulations preclude them from writing a paper which is of sufficient interest to their colleagues. Although no one will wish to deny that security and free speech are not compatible, in the field of aeronautics, where progress is so rapid, aeronautical information—which to the few is history—is to the majority knowledge and it therefore follows that as soon as anyone of us is permitted to talk of his work this, no matter what the subject, must be news to the majority. Our Society, in virtue of its very title and the fact that our daily labours lead to end-products, is in itself a very good reason why our members cannot expect to be as free as their contemporaries in sister institutions, who are not so close to the military and do not necessarily deal with any specific end-product.

To leave this subject of lectures submerged in a miasma of security without referring to the Society's lecture record of 1956 would be a gross injustice to members, and particularly to the lecturers. Last year 47 lecture sessions were held in London, including two all-day sessions, and a two-day conference arranged jointly by the Society and the Institute of Physics was held at the College of Aeronautics. The number of lectures read before branches was 162, excluding 53 other meetings, all with an aeronautical context. By any standards this is an excellent achievement and great credit is due to those who gave up so much of their own time to the general education of others. If we add to these figures the lectures arranged by the Divisions and Branches of other Commonwealth countries the growing status of our Society and the influence it now has in matters aeronautical can well be gauged.

Three additional branches of the Society were formed in Britain in 1956, making a total now of 27, and all are established in areas where there is a large aeronautical population. The value to the aeronautical industry of the work of these branches, and of the efforts made by their local officers, are both factors which we should constantly have in mind and this leads me to refer to the recent expansion of the industry . . .

Britain's aeronautical exports in 1956 reached a record high level and, what is even more important, they were a sizeable part of the country's total exports. This news must have been welcomed by the nation as a whole but it was particularly good news to members of the Society, because our members are the industries' and the users' employees or their potential employees. The Society's news is good too. More than twice the number of new members were enrolled by the Society last year than in any previous year and it is most gratifying to note that a large percentage of these are in the Student and Graduate grades. I understand, too, that the College of Aeronautics enrolled more students in 1956 than ever before. All in all, therefore, and bearing in mind the speed record which we obtained early last year, we must conclude that 1956 was both a good year for industry and for the Royal Aeronautical Society. We must not, however, even for a moment, be complacent in times when so much around us is accelerating.

There is no virtue or value in being a member of the oldest Society of our kind unless we keep it young, active and virile by recognizing that progress in aeronautics today is infinitely quicker than at any time since 1866 when the Society was formed; that the main stem of aeronautics now has many branches and more are growing; and that the science and engineering of aeronautics will continue to excite and to beckon.

The Assembly Hall of Church House, Westminster, was the scene of the presidential address.

Production in perspective: the pattern of assembly through one of Vickers' two 1,200ft halls at Weybridge, V.800 production centre. About 160 Viscounts have now been delivered.

CIVIL AVIATION

ROUTE APPLICATION

THE recommendations of the Air Transport Advisory Council on route applications from the Corporations and independents are mostly of a workaday, unspectacular nature and rarely attain headline status. But a minor landmark was reached recently, when route application No. 1,000 was received from Air Kruise, who were requesting permission to operate a Wayfarer and DC-3 service between Ferryfield and Tarbes starting in March.

The Council are careful to point out that they have not, in fact, had one thousand applications for new routes since they received their terms of reference from the Minister of Civil Aviation in July, 1952—many applications are for renewals when the period of approval has expired, or for different frequencies to be operated on existing routes.

Nevertheless, there has been a marked up-surge in pleas (which are usually made at the end of the peak season) for new routes for summer 1957, and applications are still being received. The trend of expansion is towards the inclusive tour, where the air fare may form only a small part of the charge for accommodation and travel by coach, car or rail as well. As we remarked last week, the fares that can be offered by operators who plump for mixed air and surface travel are often very low indeed, and for holiday travel—where the overall journey-time is much less than that of the train, yet long enough to satisfy a respect for the distance travelled—they should command a fairly substantial market.

In the year ended March last, 148 applications for new routes or route alterations were approved for the Minister's decision by A.T.A.C.: the number may not be quite so high over the period ending March this year, for fleets have increased in size.

Some clashes between the Corporations and the independents are almost inevitable: a recent A.T.A.C. rejection concerned a "package tour" to Portugal offering a 15-day holiday and a return air fare for £51 9s—a rate which B.E.A., who operate over the same route with faster and more modern equipment, but with considerably higher overheads, could not hope to rival.

THAT "LIVING-ROOM LOOK"

DURING *Flight's* recent visit to Lockheed and Douglas (see pages 80 to 82 and also last week's issue), we made a special point of inspecting the mock-up of the Lockheed Electra at Burbank in which is installed the much-publicized "living-room look" layout of American Airlines. J.M.R. gives his impressions as follows:

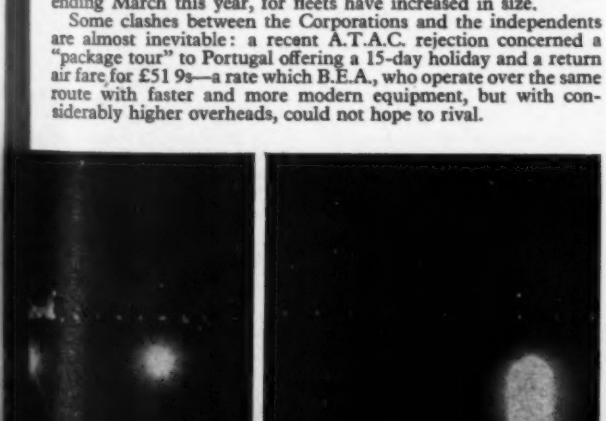
"When *Flight* first heard of this so-called living-room look we thought it worthy of leading editorial comment (October 19, 1956, issue). Having seen it I am glad we gave it this prominence, because I venture that it is the most interesting development yet in the neglected art of airliner cabin design. Flat pictures and descriptive text cannot do justice to the impression one gets of being in a lounge, and even colour illustrations do not convey the full attractiveness of the contemporary, up-to-the-minute styling, in which colour plays the dominant part, or the full harmony of the textures. The seats are armchairs, some two-abreast and others three-abreast, facing across tables. They are non-reclining, because —it is argued—they do not need to recline for short-distance Electra travel. A big part in the general effect is played by the presence of shaded table lamps, and the absence of overhead hat-racks (stowage is let into the bulkheads).

"There are two conventional four-abreast cabins for through-travellers who prefer reclining seats, but my guess is that these will be filled up last. The surprising point is that even though the cabin is subdivided into five (two conventional cabins and three "living rooms"), *more* first-class passengers (62) can be accommodated than if the whole cabin had been fitted with conventional four-abreast seats. This is because: (1) the living-room chairs are non-reclining, and therefore take up less space; (2) half these chairs are three-abreast. But they don't look at all like the triple-battery of dentist-type chairs which are the social solecism of tourist travel today—and sometimes even of first-class travel."

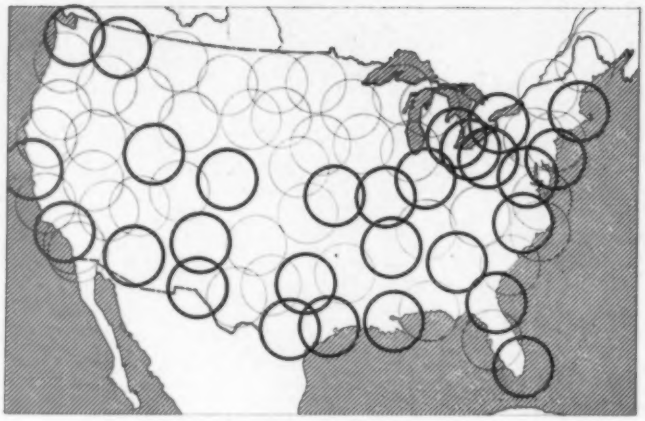
OPERATOR SUMMONED

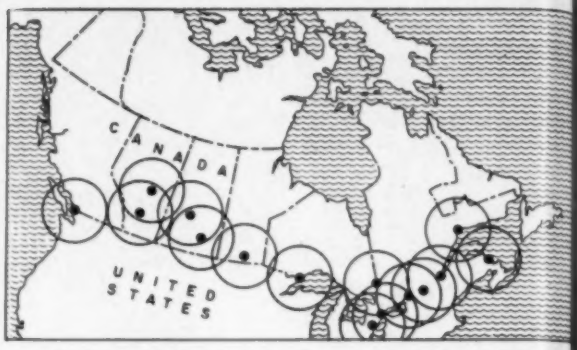
A SEQUEL to the accident to a Rapide operated by Don Everall Aviation, Ltd., at Berkswell, Warwickshire, on October 7 was the issue last week of several summonses against the owner and the pilot of the aircraft. It will be recalled that the aircraft, G-AGLR, was on a return flight from Le Bourget to Birmingham Airport at Elmdon, Don Everall's home base. Two minutes' flying time short of the airport—at 2032 hr—the port engine failed owing to shortage of fuel and the aircraft crashed and burned out. All the passengers and the pilot, Mr. J. F. Davies, escaped.

Two of the summonses allege that the pilot did not fly under visual flight rules and that the company was operating an aircraft the pilot of which did not hold a night-flying licence. The company have also been summoned for carrying an excess load on the previous day; failing to produce a duplicate load sheet for the aircraft on December 21; and failing to keep training records of a pilot between January 1 and December 1 last year.



New (fluorescent blue columnar) taxi-lamps for old. The development magician was Edward Ingraham, La Guardia airport manager. They will be installed on new taxi-ways at Idlewild and Newark in the spring.





Each radar installation shown on the map of Canada (above) and the U.S. (left) has an area coverage of 125,000 square miles. Radars indicated by heavily outlined circles will start service from this summer; light circles indicate future coverage.

CIVIL AVIATION . . .

COVER FROM COAST TO COAST

THE two maps reproduced on this page show the Airport and Airways Surveillance Radar coverage that will span the United States and Canada when the new equipment now on order is installed. The growing chain of stations represents the first answer to the tremendous traffic-control problems in which flights on high-density routes are already involved, for they provide the essential information—a clear picture of the position situation—required before any effective control can be established. But if the multiplicity of radars is not to become excessive, the surveillance equipment must be of sufficient range and reliability for many years of continuous use, and duplication and field maintenance must make each station as infallible as it is possible to achieve. It was around these requirements that the U.S. Civil Aeronautics Administration and the Canadian Department of Canada wrote their specifications for surveillance radar equipment that would give coast-to-coast coverage.

The price of the equipment is high—C.A.A.'s order for 23 radar systems is worth $9,000,000 and Canada's order amounts to $5,000,000—but in 18 months' time the United States C.A.A. controllers should have a total of 70 civil and military radar installations available with which they will be able to obtain a picture of all the traffic in all the airspace above 15,000ft, and of aircraft on the denser routes—where coverage is more closely grouped—at altitudes below that level.

Most of the new equipment is to be manufactured by the Raytheon Manufacturing Company, who are starting deliveries of their long-range radar system this summer. The company's project engineer, Mr. Bruce J. McCaffrey, in a paper prepared for the Canadian Aeronautical Institute, gave some simple explanations of the design of the equipment, and they are worth quoting here.

For the best range performance, he says, a 23cm (L-band) wavelength has been selected, and signals are transmitted from the largest practical antenna that could withstand the wind and ice that would be encountered during operations over several years. The reflector is 40ft long by 11ft high and it is claimed that the beam-width is "narrower than the 2.5 degrees specified."

The Raytheon equipment is of the dual-channel type with transmitter and receiver portions located adjacent to the antenna in a special hut, but the operator can be positioned up to two miles away; the second channel is normally kept warmed-up but inactive. The limiting range—giving a 50 per cent probability of detection—is 88 miles; almost solid display is obtained from a small target at 65 miles. The manufacturers claim that—because of basic *system* design—new units can be combined with those already developed at the dictates of air traffic needs.

It is generally well known that "circular polarization" can reduce the susceptibility of a radar to interference by rain or precipitation which will clutter the scope; but perhaps less well appreciated are the mechanics by which this is achieved.

The A.A.S.R. provides linear polarization for normal operation, and circular polarization can be manually selected by the operator. Effective discrimination of circular polarization between rain or aircraft return, states Mr. McCaffrey, is due to the reflection against spherical raindrops of circularly polarized waves as circularly polarized waves; a right-handed wave becomes left-handed when it is reflected from a symmetrical reflector, just as the mirror image of a reflected right-handed machine screw appears left-handed. An antenna which originates an outgoing right-handed circularly polarized wave cannot respond to the left-hand wave from the raindrop—and since an aircraft is not a symmetrical reflector, it scrambles the polarization of the wave it reflects, although not so completely that the antenna which originated the incident wave cannot respond.

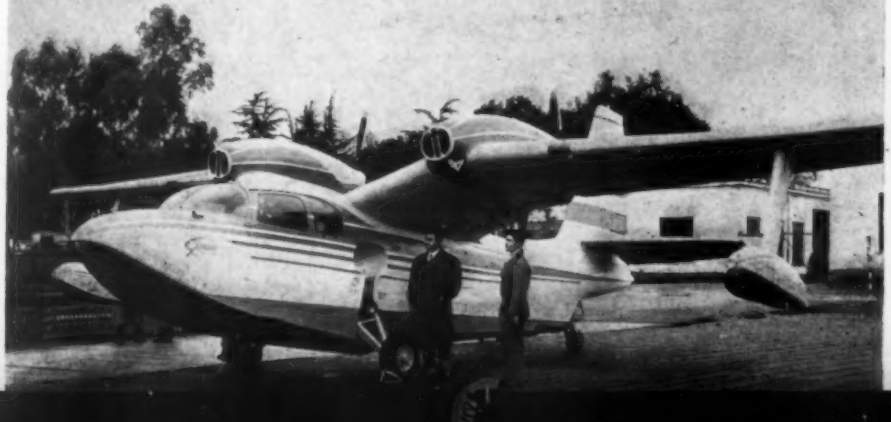
Other refinements of the A.A.S.R. are the inclusion of a video mapping generator and "moving target indication." The map, which can be of varying scale, is generated electronically on to the face of the operator's radar scopes, so that the geographical position of the "blip" being followed can then be pin-pointed. Moving target indication—inevitably reduced in the jargon of initials to M.T.I.—is a filtering process which cuts out reflections from stationary objects and reduces the indications of the scope to those that are moving.

B.E.A. COMMERCIAL APPOINTMENTS

SEVERAL new appointments resulting from changes in the B.E.A. commercial department have been announced by the chief executive, Mr. A. H. Milward.

In future the department will be known as the commercial and sales department under its director, Mr. Philip Lawton. He is to be assisted by two general managers, Mr. Clive Adams (in charge of sales) and Mr. J. L. Grumbridge (commercial affairs); and Mr. Adams will also act as deputy to the director.

Mr. Grumbridge's former post as B.E.A. sales manager will be taken over by Mr Henry Hill, together with general responsibility for the reservations branch. Mr. G. H. Wharton, now handing over his post as sales manager (North America), to Mr. John Norton, is to become passenger sales manager, responsible to Mr. Hill; while Mr. L. R. Dougal will take charge of the London sales district. Mr. H. V. Richards is to remain responsible for B.E.A.'s agency and interline affairs.



This Piaggio P.136-L amphibian will be used in the summer to ferry passengers between Naples and Capri. The type is being assembled for sale in the U.S. by the Royal Aircraft Corporation of Milwaukee.

The sprayed metal elements in the Napier Spraymat fitted to the Fokker Friendship (see text) are shown, left, being checked for uniformity.

Superslumber - Sleeperseat —the Microcell seat newly ordered by B.O.A.C. to their "Slumberette" specification. It is light, 21in wide and adjustable over a range of angles. Pairs of seats form a double berth.

PUTTING ON THE HEAT

AMONG the satisfying quantity of British equipment on the Fokker Friendship is Napier's electrical anti-icing "Spraymat." Although on the prototype aircraft Napier's ice-protection contribution was limited to the alternator cooling-air intakes, the second prototype will rely on Spraymat de-icing for the complete tail unit and sections of the wing leading edges—this involves the alternator cooling intakes as before, and the air intakes to the combustion heater units.

Two alternative de-icing systems are offered for the Friendship; the standard arrangement provides inflatable rubber overshoes on the leading edges; the optional system is hot-air thermal de-icing for the wings and cyclic electro-thermal de-icing on the tail unit. The electro-thermal system, which is to be a Napier design, includes ancillary equipment manufactured by Rotax, Rolls-Royce, Rotol and Teddington Controls. It has yet to be flown; the first series of flight tests will take place towards the end of the year, when Napier and Fokker technicians will co-operate to obtain official clearance of the system in the second prototype.

The Spraymat (a photograph of which appears above) consists of a series of flame-sprayed metal elements embedded between layers of insulating material. In most cases the base insulation acts as an adhesive to secure the heater to the structural component, but the Friendship is particularly suited to Spraymat application, as the tail surface's leading edges are constructed from polyester-resin-reinforced glasscloth material, and the base insulation layer is no longer necessary.

JAPANESE YEN FOR DOUGLAS EQUIPMENT

THE Export-Import bank have credited Douglas with $24.2m to assist their sale of DC-7Cs and DC-8s to Japan Air Lines, who have four aircraft of each type on order—the DC-7Cs for delivery this year and in 1958 and the DC-8s for delivery in 1960 and 1961. The financial arrangements for Japan's Douglas orders stipulate that 25 per cent of the purchase price ($29m for the jets, and about $13.5m for the DC-7Cs) must be provided as a down payment by the buyer and a further 25 per cent as participation by the supplier. The credit to Douglas for the sale of DC-8s is for seven years, repayable from 1960, and for the DC-7Cs five years, repayable in instalments from 1958.

BREVITIES

LORD DOUGLAS OF KIRTLESIDE has been reappointed chairman of British European Airways for a further period of three years from March 14, 1957. Lord Douglas, who is also deputy chairman of Aer Lingus and Alitalia, and a member of the A.R.B., the Institute of Transport and President of I.A.T.A., has been chairman of B.E.A. since 1949.

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Qantas introduced Lockheed Super Constellations on their weekly Hong Kong - Sydney service on January 6.

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The first prototype Fokker Friendship has flown 325 hours between its maiden flight on November 24, 1955, and the end of 1956.

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B.K.S. have been granted permission to operate a passenger air service from Newcastle to Dublin. The company expect to carry a substantial holiday traffic.

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The C.A.A. have borrowed two F-80Cs and a T-33 from the U.S.A.F. for training their key aviation inspectors and flight-test engineers.

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Last Friday, January 11, the first Britannia 312, G-AOVA, made an endurance flight of 13 hours from Filton, during which it covered over 4,300 miles.

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Hong Kong Airways have been granted temporary permission by the Philippine Civil Aeronautics Administration to operate between Manila and the Crown Colony. They will start a Viscount service on February 25.

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General Aldo Urbani, the new president of L.A.I., has said that the airline—which, he added, intends to merge with Alitalia—hopes to compete with other companies' transatlantic services by purchasing jet airliners.

* * *

A big increase in vehicle, freight and passenger traffic was recorded on Silver City's Stranraer - Newtownards air ferry in 1956. Cargo (419,000 lb) increased 175 per cent; passenger traffic 77 per cent and vehicle traffic 69 per cent.

The price of the Convair 880 (30 of which have been ordered by T.W.A. and ten by Delta) is now given as £1,155,000.

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Dutch-American negotiations on K.L.M. landing rights at Los Angeles and Houston are to be resumed in Washington on March 18.

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Air-India International produced 20,155,267 capacity ton-miles —an increase of 14.3 per cent over the previous half year—in the first six months of 1956.

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Business transactions through the Airlines Clearing House were 23.52 per cent greater in October 1956 than in the same month last year.

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Mr. John Kinch, B.W.I.A. reservations officer in Barbados, has been promoted to the post of district sales manager. His place has been taken by Mr. Cecil Ince.

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An agreement permitting an increase in civil landings and take-offs from the R.A.F. base at Wahn airport, near Bonn, from 94 to 162 per week, has been reached between the R.A.F. and the German civil authorities.

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Eagle Airways will begin a new "Swiss Eagle" Coach/air Viking service between London Airport and Basle on April 18. The mid-week return fare (including refreshments) will be £16. Other new Viking services will operate to Jersey, La Baule and Saragossa.

* * *

Encouraged by the response to their newly announced cheaper "Blue Arrow" coach-air-rail services, Air Kruise are now offering first-class rail travel at no extra cost on their Aix-les-Bains, Turin and Milan routes.

* * *

Manston Aerodrome, Kent, which has been transferred from R.A.F. to U.S.A.F. control, can no longer be made available to chartered civil aircraft, but it will continue to provide master diversion facilities and will be available as a supplementary aerodrome for scheduled-service aircraft on transatlantic and European routes.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Here being greeted at Brough by Mr. Eric Turner, chairman and managing director of Blackburn and General Aircraft Co., Ltd., is Air Marshal Andrew McKee, C-in-C. Transport Command. The air marshal arrived, on a visit to the works, in a D. H. Devon.

Senior Appointments

IT is announced that A. Cdre. T. U. C. Shirley, C.B.E., who has been taking the 1956 course at the Imperial Defence College, has been appointed Air Officer Commanding and Commandant of the R.A.F. Technical College at Henlow, Beds.

G/C. H. J. Maguire, D.S.O., O.B.E., Deputy Director of Air Defence Operations at the Air Ministry since June 1955, has been appointed Director of Tactical and Air Transport Operations, with the acting rank of air commodore.

G/C. J. R. Gordon-Finlayson, D.S.O., D.F.C., has been appointed Assistant Commandant of the R.A.F. Staff College, Bracknell, Berks, and G/C. P. G. Jameson, D.S.O., D.F.C., has been appointed Deputy Senior Air Staff Officer at H.Q. 2nd Tactical Air Force, Germany, both with the acting rank of air commodore.

More CF-100s for Europe

THE second R.C.A.F. squadron of CF-100 all-weather fighters to leave Canada for NATO duty with the Air Division in Europe is scheduled to make its overseas move during February. The squadron—No. 423—will fly its aircraft across the Atlantic and will be based at No. 2 Fighter Wing, Grostenquin, France. The flight will be supported by Air Transport Command, and about half the ground crew of the squadron will move with their unit. Two more CF-100 squadrons will follow No. 423 at later dates, and will be located at the two other R.C.A.F. fighter wings, at Zweibrucken and Baden-Soellingen, both in Western Germany.

As 423 Squadron takes off from St. Hubert on its eastward flight a Sabre squadron now at Grostenquin will be disbanded and simultaneously a new CF-100 squadron will come into official being at St. Hubert. The Sabre squadron is 416, and it will be replaced at Grostenquin by 423 Squadron. The 416 designation will be given to the new CF-100 squadron to form at St. Hubert.

No. 423 Squadron was formed as a flying-boat unit at Oban, Scotland, in May 1942, and moved to Northern Ireland later in the year. Flying Sunderlands, it operated out of Northern Ireland during the remainder of the war on convoy escort and anti-submarine operations. The squadron was credited with five U-boat kills, two being shared with the R.C.N. and R.N. The squadron was disbanded in the United Kingdom in September 1945, as it was in the process of converting to transport duties. It was re-formed in June 1953, at St. Hubert, as Canada's second CF-100 squadron.

R.N.V.R. Retirement

THE commanding officer of the Northern Air Division, Stretton, Cdr. R. I. Gilchrist, M.B.E., V.R.D., R.N.V.R., retired on January 1. An appreciation by a brother officer reads:—

"His strong, efficient personality has been the driving force behind the voluntary flying and administrative organization of two hundred technical and executive officers and ratings. He will be missed badly. At 25 years of age he joined 1831 Squadron, on its formation at Stretton in 1947. Within twelve months he was promoted lieutenant-commander in command. The second squadron, 1841, was formed in 1953. The unit was given Divisional status and 'Gillie,' already an M.B.E., got his 'brass hat' and has commanded the Division ever since. That is the plain record; some of the details are extraordinary. 'Gillie' is a brewer. Flying over his brewery he spotted something unusual, landed quickly and 'phoned the police, who were just in time to catch burglars in the act. Later, a Press hand-out announced that he would lead a small, tight formation to salute the Lord Mayor of Manchester. He became a headline: 'Brewer leads "tight" formation.'"

Cdr. Gilchrist led several notable flypasts, including that of a hundred aircraft which saluted Her Majesty the Queen at the R.N.V.R. Jubilee Review.

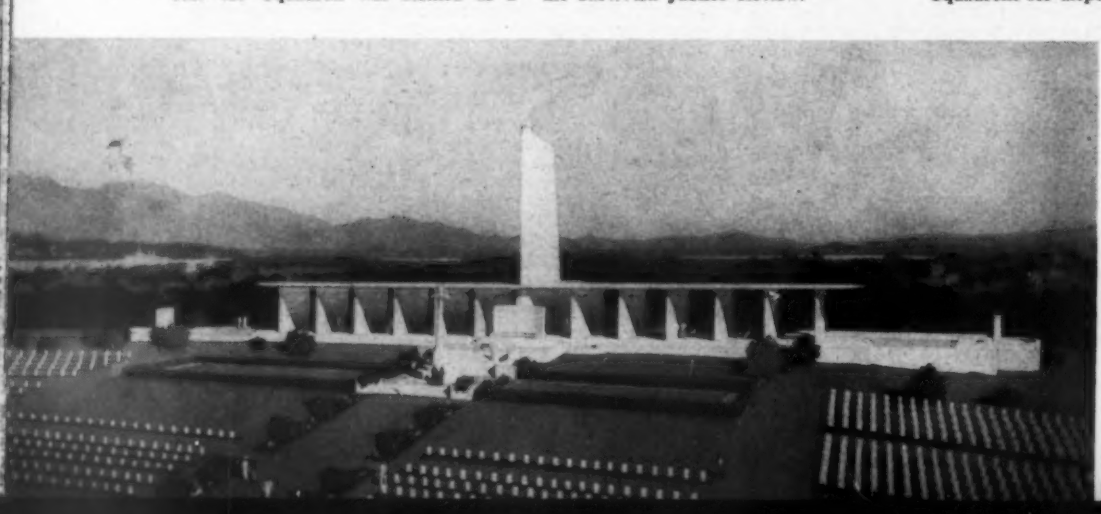
The Singapore Memorial

THE Governor and Commander-in-Chief of Singapore, His Excellency Sir Robert Black, K.C.M.G., O.B.E., will unveil the Singapore Memorial on Saturday, March 2. This memorial has been constructed by the Imperial War Graves Commission in the Kranji War Cemetery, near Singapore, to commemorate 24,000 men and women of the Land and Air Forces of the Commonwealth who have no known grave. Individual letters of invitation to the ceremony are being sent to the next-of-kin of each man commemorated on the memorial or buried in the war cemetery itself.

The cemetery and memorial have been designed by Mr. Colin St. Clair Oakes, M.B.E., T.D., F.R.I.B.A. The entrance to the cemetery is through a wrought iron gateway leading to a terrace on which stands the Stone of Remembrance, a traditional feature to be found in the larger war cemeteries throughout the world. From the gate the central avenue of the cemetery passes between two shelter buildings and rises gently to the Cross of Sacrifice, which is common to all war cemeteries. Behind the Cross, flights of steps lead to the terrace on the summit of the hill on which the memorial stands. The memorial consists of twelve wide columns bearing the name panels and supporting a flat roof giving protection to the inscribed names and shade and shelter to the visitor. Rising through the roof in the centre, to a height of 80ft, is a great pylon surmounted by a star.

Squadron Histories

WE are informed by Mr. J. L. Dixon, of 11 Rickaby Close, Bridlington, E. Yorks, that he has a few copies of brief histories of Nos. 62, 249, 264, 151 and 201 Squadrons for disposal, price 2s per copy.



The Singapore Memorial as it will appear when completed. The memorial is described in a paragraph above.